

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FLIGHT RESEARCH CENTER
Edwards, California

3 May 1960

X-15 Flight Record

X-15-2

Captive 24 July 59 Speed: .82 Altitude: 45,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Robert Baker (NAA)
Maj. White
Walker (NASA)

Captive 4 Sept 59 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Capt. Rushworth (AF)
Al White (NAA)
Walker (NASA)

Captive 10 Oct 59 Speed: .82 Altitude: 47,450 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Rushworth (AF)
Daniels (AF)
White (AF)

Captive 14 Oct 59 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Major White (AF)
Al White (NAA)
Walker (NASA)

Captive 22 Oct 59 Speed: .82 Altitude 45,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Allavie (AF)
Chase: Major White (AF)
Al White (NAA)
Walker (NASA)

Power: 11 Feb 60 Speed: 2.2 Altitude: 88,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: Major White (AF)
Al White (NAA)
Walker (NASA)

Power: 17 Feb 60 Speed: 1.56 Altitude: 53,400 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: White (AF)
Walker (NASA)
White (NAA)

Power: 17 Mar 60 Speed: 2.15 Altitude: 52,640 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt Allavie (AF)
Chase: White (NAA)
White (AF)
Walker (NASA)

Power: 29 Mar 60 Speed: 1.96 Altitude: 48,799 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: White (AF)
Rushworth (AF)
Knight (AF)

Power: 31 Mar 60 Speed: 2.03 Altitude: 51,420 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: White (AF)
Rushworth (AF)
Knight (AF)

Captive: 31 Oct 59 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt Allavie (AF)
Chase: Major White (AF)
Al White (NAA)
Walker (NASA)

Captive: 4 Feb 60 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: Capt. Rushworth (AF)
Al White (NAA)
Walker (NASA)

Captive: 18 Mar 60 Speed: .82 Altitude: 45,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: White (NAA)
Walker (NASA)
Rushworth (AF)

Power: 17 Sep 59 Speed: 2.1 Altitude: 52,500 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Major White (AF)
Al White (NAA)
Walker (NASA)

Power: 17 Oct 59 Speed: 2.15 Altitude: 62,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt Allavie (AF)
Chase: Robert Baker (NAA)
Major White (AF)
Walker (NASA)

Power: 5 Nov 59 Speed: 1. Altitude: 45,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Allavie (AF)
Chase: Major White (AF)
Robert Baker (NAA)
Walker (NASA)

X-15-1

Captive:1 10 Mar 59 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: White (NAA)
White (AF)
Rushworth (AF)

Captive 2 : 1 Apr 59 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Roberts (NAA)
White (AF)
Wood (AF)

Captive 3: 10 Apr 59 Speed: .82 Altitude: 45,000 Feet

Pilot Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: White (NAA)
White (AF)
Rushworth (AF)

Captive 4: 21 May 59 Speed: .75 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: Rushworth (AF)
White (AF)

Captive 5: 16 Dec 59 Speed: .82 Altitude: 45,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Allavie (AF)
Chase: White (NAA)
White (AF)
Walker (NASA)

Glide: 8 June 59 Speed: .82 Altitude: 38,000 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Capt. Bock (AF)
Chase: White (AF)
Wood (AF)
Roberts (NAA)

Power: 23 Jan 1960 Speed: 2.53 Altitude: 66,300 Feet

Pilot: Crossfield (NAA)
Pilot B-52: Major Fulton (AF)
Chase: Baker (NAA)
Walker (NASA)
White (AF)

Power: 25 Mar 60 Speed: 2.01 Altitude: 48,630 Feet

Pilot: J. Walker (NASA)
Pilot B-52: Major Fulton (AF)
Chase: Crossfield (NAA) -Daniels (AF)
White (AF)
McKay (NASA)

Power: 13 Apr 60 Speed: 2. Altitude: 50,000 Feet

Pilot: Major White (AF)
Pilot B-52: Capt. Allavie (AF)
Chase: White & Crossfield (NAA)
Walker (NASA)
Rushworth (AF)

Power: 19 Apr 60 Speed: 2.6 Altitude: 60,000 Feet

Pilot: J. Walker (NASA)
Pilot B-52: Major Fulton (AF)
Chase: Rushworth (AF)
Knight (AF)
McKay (NASA)

HOLD FOR RELEASE UNTIL DELIVERY
EXPECTED 2:00 P.M., PDT
MAY 10, 1960

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ROCKET POWER -- KEY TO SPACE SUPREMACY

Address by Maj. Gen. Don R. Ostrander, USAF, Director, Launch Vehicle Programs, National Aeronautics and Space Administration, at the Semi-Annual Meeting of the American Rocket Society at Los Angeles, California, on May 10, 1960.

I chose the title for my talk today very deliberately. I thought it was appropriate because I, as the one who has the responsibility for producing the launch vehicles for our space program, am probably the man who is more interested than anyone else in the country in increasing the thrust and the weight-carrying capability of our vehicles. And I am speaking to the group upon whom we are going to have to rely to achieve this - the American rocket industry.

The question has been repeatedly asked and heatedly argued in recent months as to whether we are in a space race with Russia. Now, whether we are in an overall space race with Russia is, I guess, a matter of semantics. The word "race" normally connotes two or more contestants running on the same track, taking the same hurdles, and trying to reach the same goal. In this case we don't know what the other track is like, we don't know what the specific goal of the other fellow is, and we don't know how hard he is running. In addition, I think it would be a mistake, even if we knew these things, to try to pattern our program on his in a sort of "me too", "anything you can do, I can do better" approach. I think that we should set our own goals, point towards them with a broad, logical, scientifically sound program, and then run just as hard as we can. In the long run I firmly believe that we will be better off than by simply shooting for spectacular propaganda firsts. If in the process we achieve significant firsts, fine, but it should be as an outgrowth of our own sound program, not as our sole and primary goal.

Leaving semantics aside, however, I think that we have to face the fact that we are in a competition - whether or not you want to call it a race - just as we are in financial, economic, psychological and ideological competition across the board. Certainly there is no question in my mind that in my area of responsibility, the area of greater rocket weight-lifting capability, we are in a race and I plan to conduct my business accordingly.

Recognizing then and admitting that it is a competition or a race, or whatever you want to call it, let's review where we stand to date.

Since the Soviets placed SPUTNIK I in orbit in October of 1957, the United States has attempted 40 satellite launchings. These efforts succeeded in injecting 18 payloads into earth orbits, 9 of which are still aloft. During this same period we have tried 5 lunar or deep space probes, of which two can be classed as successes.

I think that it is interesting to try to interpret trends from these statistics. The record shows 17 major launchings by the United States in 1958 and 19 in 1959, with a box score of 47% successes in 1958 rising to 58% in 1959. Before we get too exuberant over this achievement, though, I must point out that we are down to 50% in 1960 so far.

What do these statistics mean? Well, I think they point up several things that are significant. First of all, 45 major launches in a little over two years represent a beginning for our space program of a not inconsiderable magnitude. So far our choice of vehicles has been limited to direct descendants of those with which we began our space effort. All to date are improvisations using components developed either under our various missile programs, or for the VANGUARD IGY program. The second point is the importance of repetitious use of a vehicle in increasing its reliability. The marked upswing in reliability in 1959 can be laid, I think, to improvements in design and to the correction of component deficiencies

which were made after diagnosis of our failures. The fact that our record in 1960 has slipped from its 1959 level is attributable in part to the small sample involved - we have attempted only 8 launchings in the first four months of this year. In addition, however, the fact that most of the failures this year have occurred in the AGENA which, even with these failures, has the best record for reliability of any American launch vehicle, emphasizes the necessity for caution in predicting high reliability rates for multi-stage vehicles, and the essentiality of a strong, continuing reliability program throughout the life of a vehicle.

We have no accurate way to determine the reliability which the Russians have achieved in their space program so far. We know of six Soviet successes but we do not know, of course, how many of their attempts resulted in failure. I am sure, though, that all of you in this audience can conclude from your own experiences that their rate falls something short of 100%.

It is no secret that the Soviets outmatch us in the department of rocket thrust, and that as a result they have the capability of placing much heavier payloads in space than have we. You can get any number of very lucid rationalizations of how the U. S. came to trail the Soviets in the matter of rocket size. One of these explanations points out that both the Soviet and U. S. boosters are based on ICBM hardware. Each nation sized its rocket engines to place a high yield warhead on an intercontinental target. Our U. S. warhead technology permitted a lighter vehicle requiring lower thrust than that of the Soviets. All of this is true, but regardless of the reason, the facts of life are that the Soviets did have a large booster vehicle in 1957. With the exception of the VANGUARD program, our development of specialized space vehicle hardware did not really get under way until about a year later. When you consider the remorseless facts of rocket development lead times,

think that it is understandable why we have yet to put into service the new, higher thrust launch vehicle hardware which will enable us to match or surpass Soviet payload achievements.

Although we are behind the Soviets in the weight lifting area, it does not follow that we are far in arrears in overall rocket technology - in our knowledge of how to design, develop and use advanced rocket systems. In fact, I am confident that we are not significantly behind the USSR if you consider this field as a whole, and I think that we may well lead them in many areas.

I have discovered that trying to find out where we stand relative to the Soviets in the field of guidance is a pretty futile exercise. I can get as many opinions as there are experts. Several of our vehicles which are now in or nearing operational status have guidance systems which their salesmen claim have an absolute capability of duplicating the feat of LUNIK III in sweeping around the moon's backside. They point out that the test of a guidance system is not whether a particular LUNIK successfully accomplished this maneuver, but its probability of repeating the performance. That may all be well. The fact remains that they did it, and I, for one, am impressed with it. However we stack up with them today in the field of guidance and control, it appears to me that we are certainly going to need some advancements in the state of the art in order to design a system with the precision and dependability required for the manned lunar landing and earth return mission, for example.

From the standpoint of numbers, our 18 satellites placed in orbit compare very favorably with the Soviet 3, or our total of 23 successful major launchings with their 6, for that matter. From the standpoint of total weight of scientific instrumentation launched into earth orbits, the Soviets are ahead of us by several thousand pounds, and we have not even approached their achievement in payload weight

1 lunar and deep space probes. However, the yardstick by which our space accomplishments should be measured is not solely by payload weight, nor for that matter the total number of successful launchings, but rather the extent and quality of useful scientific information our payloads have returned to us and the distance this new knowledge has carried us toward our goals.

Our knowledge as to the scientific value of the data that the Soviet space program has gathered to date is far from complete. There is, therefore, no real way for us to compare the two programs thus far. However, our own effort has contributed very significant information of great value to our overall program.

Our program of space exploration really has three elements with related goals. The first of these is the Space Sciences program, which seeks to learn new facts about the shape of the earth, its upper atmosphere, the ionosphere, the earth's magnetic field, cosmic rays, the radiation belt, the aurora, solar-terrestrial relationships, astronomy, etc. Each of our satellites and space probes in this program is instrumented and its flight path is planned to add in a specific way to the overall pattern of knowledge we are painstakingly building. Often some of the most important information comes to us quite by accident. An example is the discovery of the belt of high energy particles from the flight of EXPLORER I, our first satellite, which was probably the most important discovery of the International Geophysical Year. Dr. van Allen and his colleagues had instrumented the payload to observe the primary cosmic ray intensity outside the atmosphere. Saturation of their counters provided the clue which led to further exploration and finally to the now generally accepted theories as to the source of this phenomenon. Subsequent flights by EXPLORERS III and IV provided further data on the Van Allen belt, plus a great deal of other highly useful information.

Interestingly enough, several of the space probes which I classed as failures in the tally I gave you a few minutes ago actually returned a significant amount of valuable information on this phenomenon. For example, PIONEERS I, II and III in late 1958 determined the radial extent of the van Allen belt, discovered a second radiation belt around the earth, and in addition measured a significant departure of the earth's magnetic field from the theoretical predictions.

A great many of the experiments undertaken as part of the Space Sciences program are inspired by requirements of other elements of our program. For example, determination of the extent, intensity, and time variations of the radiation belts; measurements of temperatures inside and on the outside surfaces of satellites; and measurements of the energy and frequency of micrometeorite impacts, all are of great importance to the MERCURY and follow-on man-in-space programs.

This, of course, is the second element of our NASA space program. The goal of Project MERCURY is not the propaganda value of a spectacular first. Rather, its goal is to determine the functions that a man can perform in space to pay his way in future space exploration. Man is a complex servo mechanism - a computer endowed with reason - but he is a pretty delicate mechanism compared with electronic devices and imposes environmental demands which compromise design and cost weight. So one of the things we are trying to find out is for which missions he is worth all this complexity and weight. We have made excellent progress with MERCURY so far. If all goes well, an astronaut should make his first sub-orbital flight this year, and orbit the earth in 1961.

The third element of our program relates to the application of the knowledge which we gain to space systems which can be applied to the good of mankind. For example, as you know, we plan to place in orbit under our Project ECHO, large, metallic coated mylar spheres which can be used as passive reflectors to permit

microwave communication over vast distances. Also, weather satellites such as TIROS I, which is still returning excellent televised pictures of cloud cover, and its successors, TIROS II and NIMBUS, will, we hope, allow major advances in weather forecasting.

Thus we are, I think, embarked on a scientifically sound, balanced and aggressive program of our own design. We are literally building our fund of knowledge of space from the ground up, guided by definite goals - our own goals. To date we have been less handicapped by the lack of greater payload capability than is popularly supposed, because much of this early exploratory work which forms the foundation of our later efforts can, with proper planning, be accomplished with the rather primitive tools that we have available. I don't mean to imply that we wouldn't be delighted to launch heavier payloads, and in the near future we are going to have to have order of magnitude increased in our ability to carry heavier weights into space. We are going to have to fly more complex flight paths, and we are going to need a higher degree of guidance precision than we have needed so far.

Now, let us examine our program to create this new generation of launch vehicles we need for the task ahead.

The philosophy upon which our launch vehicle program rests is based upon three fundamental precepts:

- first, we are creating a standardized fleet of trucks, if you want to call it that, with a minimum number of different types in the fleet;
- second, closely linked to the first, we propose to attain reliability through repetitive use of the vehicles in our fleet; and
- third, to avoid early obsolescence, we want to insure that each new vehicle we develop incorporates the most advanced technical approaches and growth potential consistent with the reliability we require.

Before discussing the present and planned vehicles in our program, I would like to dwell for a moment on this philosophy and some of its implications.

Speaking of the first two of these precepts - minimum variety and repetitive use of standardized vehicles - our objectives here are, of course, economy and reliability. The costs of developing launch vehicles are already high and they are going up in a geometrical progression with each new, larger, and more advanced vehicle that we add to our fleet. The Nation cannot, and fortunately need not, afford two major vehicles, one NASA, one military, with approximately the same capability. That is why we are conducting cooperative programs with the military on the SCOUT, the AGENA B, and the CENTAUR. That is why, too, that we cancelled VEGA in favor of the Air Force AGENA B. There was nothing inferior about the VEGA vehicle. It was just that the AGENA B was a little ahead, time-wise, and could do the same job, plus the fact that with a cooperative program we would get more total firings and consequently more reliability.

While on the subject of a minimum variety and repetitive use of vehicles, I want to stress that this same philosophy governs the NASA component and technique development program. We explore various technical approaches methodically and, I think, adequately, in our applied research efforts. But we try to settle on one approach which our analysis shows to be best before we go into full scale hardware development. An example is our decision to use liquid hydrogen and liquid oxygen as a propellant-oxidizer combination for chemical upper stages. We made this choice after a lot of careful study and experimentation. We plan to use this combination in nearly all of our chemical upper stages in preference to other competitive combinations. Meanwhile, just to be sure we have not overlooked a break-through, we will continue researching other combinations, but at a lower level of effort and on a highly selective basis.

I think the contribution to reliability of amassing a large number of flights on a given vehicle is obvious. I want to add, though, that we do not subscribe to the "develop in haste and fix at leisure" route to reliability. In our kind of business such an approach is patently unacceptable. These devices have to work the first time they are launched or the entire cost of the flight is wasted. NASA is reliability-conscious to the point where I think some of our project people would be glad if they never heard the word again. We have recently added a staff element, headed by Dr. Landis S. Gephart, to direct the NASA-wide reliability program. Our operating elements, such as the George C. Marshall Space Flight Center in Huntsville, have engineering groups whose sole business is to insure that reliability is considered at every step, from conceptual design, through detail design, selection of materials and components, development test, flight test, production quality control, and launch procedures - the entire spectrum of operations which influences the probability that complex launch vehicles, spacecraft, and all the myriad elements that make up the space mission systems, will function as intended.

On the other hand, we cannot allow our desire for reliability to become such an overriding obsession that we timidly decide on the tried and true - and often desolent - approach in planning each new vehicle. That is why we have the third precept I mentioned. The tough job is to have both reliability and long, useful life. NASA is tackling this job by aggressively probing for real break-throughs which promise quantum gains in mission capability. We bet heavily, to win, only after we have solid evidence that we have a winner. An example is the ROVER program which I would like to talk about a little more later on.

Now I would like to discuss, very briefly, the vehicles we now have in our fleet, and the standardized ones we are developing for the future.

As I mentioned earlier, we are still limited to the launch vehicles with which the U. S. began its space program, or their direct descendants. A few have been retired - the JUPITER C which served us so well back in 1958 when we so greatly needed a U. S. satellite in orbit to repair, in some measure, our badly mauled prestige; and the VANGUARD which, in spite of its troubles, more than earned its development cost in the information provided by the three scientific payloads it orbited. In addition, it paid dividends by giving us upper stages for the THOR-ABLE, the THOR-DELTA, and the SCOUT.

Also due to be retired this year is the JUNO II, based on the JUPITER IRBM, and the THOR-ABLE. The THOR-DELTA, which is a THOR-ABLE improved through the addition of coasting flight attitude control and the accurate and flexible TITAN radio guidance system, will be used through 1961 in a 12-vehicle program, but no follow-on procurement is planned.

All of these vehicles are destined to be replaced by two vehicles, the SCOUT and the THOR-AGENA B - the SCOUT because of its relatively low cost, which is about \$750,000 per copy including all launching costs, and its high reliability potential; and the THOR-AGENA B because of its combination of greater payload, flexibility of operation, and potential high reliability.

As far as payload capability is concerned, the VANGUARD and JUPITER C could place in a 300 mile orbit about a 25-pound payload. The JUNO II could perform the same mission with a 100-pound payload, the THOR-ABLE 200 pounds, and the DELTA configuration will more than double this performance with about a 480-pound capability for this particular mission. Of their successors, SCOUT can handle a 200-pound payload for a fraction of the cost, and the THOR-AGENA B will be able to put 1,250 pounds in a 300 mile orbit.

The AGENA B stage will also be used by NASA, as well as the Air Force, on top of the ATLAS as a first stage. The ATLAS booster will increase the 300 mile orbit payload capability of the AGENA B to about 5,300 pounds.

Later in 1961 we are scheduled to launch our first CENTAUR. The CENTAUR will be the first vehicle to employ a high energy upper stage, and this liquid hydrogen-liquid oxygen stage is the first to employ a rocket engine developed primarily for space use. The added specific impulse afforded by hydrogen as a fuel gives the CENTAUR half again the payload of the ATLAS-AGENA B in a low orbit, and nearly three times as much payload when used as a lunar probe, which is one of its principal missions in the NASA program. For the first time, in CENTAUR, the U. S. has a launch vehicle able to duplicate the payload capability of the SPUTNIK vehicle.

The CENTAUR is of major interest to the Department of Defense as well as to the NASA. In fact, the CENTAUR performance objectives originally stemmed from the DOD requirements for a 24-hour communications satellite. The importance of the CENTAUR to NASA, however, is much more far-reaching than the capability of the CENTAUR vehicle itself because of its relationship to SATURN. The CENTAUR upper stage will become the top stage for SATURN. In addition, four CENTAUR engines will power the second SATURN stage. In fact, liquid hydrogen begins to look as though it will dominate the launch vehicle upper stage picture both as a fuel for chemical rockets and as a working fluid for nuclear rockets.

The SATURN vehicle is being developed under the management of Wernher von Braun's Marshall Space Flight Center. As most of you know, the SATURN first stage consists of a cluster of eight uprated JUPITER-THOR type engines, with a total thrust of 1,500,000 pounds. On top of it we will use the two hydrogen-oxygen stages I just mentioned. When we get this SATURN C-1 vehicle, which is the initial version of SATURN, our payload capability gets a king-sized boost - to 25,000 pounds in a 300 mile orbit.

One, and possibly two later versions of SATURN are planned. The second model, called C-2, will add another stage using four 200,000 pound thrust LO_2 - LH_2 engines. The third model, if we decide to build it, will be called the C-3 and will have still another stage, using two of these 200,000 pound thrust engines.

We have had a great deal of study and analysis in progress for the past year to try to define the vehicle which will follow the SATURN. The principal mission which we have used as an objective in these planning studies has been that of landing a manned spacecraft on the moon, then returning a 10,000 pound reentry package to the earth. The study has followed two principal approaches. The first was what you might call the brute force attack, known as NOVA.

There have been many references to NOVA, as a vehicle, in the press and elsewhere. NOVA is not a vehicle - it is simply one of a number of vehicle concepts which we have considered for the use of the 1,500,000 pound thrust single chamber F-1 engine now under development for NASA at Rocketdyne. Under this brute force approach, six of these large $1\frac{1}{2}$ million pound thrust engines would be used in the first stage. Four hydrogen-oxygen stages could be piled on top of this big booster to give us the 10,000 pound lunar return package that we need.

This concept is beginning to face increasing competition from vehicle studies with nuclear upper stage rockets. Encouraging results from the initial KIWI-A nuclear rocket reactor test last summer have stimulated our hopes that the large increase in efficiency which we get from using one or more nuclear upper stages, with weights less than one-third that of the NOVA for the same mission capability, can be acquired by the time our program has reached the point where we need something beyond SATURN. Toward that end, the NASA and the AEC are increasing the pace of the ROVER program, as the nuclear rocket program is known, aiming for an orbital flight test of a prototype nuclear rocket in 1965, on top of SATURN as a launch vehicle.

The NASA has developed, during the year and a half of its existence, a long range plan. We have done this in order to set ourselves some long range goals and a tentative timetable for reaching those goals, so that our research and development program could be constructed by a process which more nearly resembled interpolation than extrapolation. This planning effort has given our program, I believe, a clear sense of direction and pace.

As to direction, the major long range goal of the NASA program is manned exploration, first of the moon, then the nearer planets. This goal focuses attention on the vehicle development program, the MERCURY program and follow on manned earth satellite programs, preliminary unmanned explorations of the lunar surface, the variation of the space environment between the earth and the moon, and on all the host of basic and applied research which must provide us with the information we need to realize this goal.

The plan also projects the space sciences and satellite applications programs. As I mentioned before, the Space Sciences program gains direction and emphasis from this objective of ultimate manned lunar and planetary exploration. Our satellite application program will continue to develop improved means of microwave communications and improved means of forecasting weather through meteorological satellites.

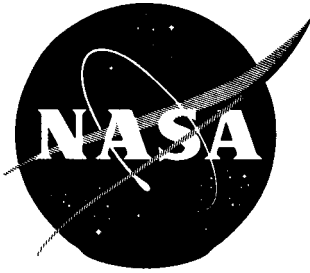
To carry out these programs, NASA will launch between 25 and 35 major vehicles and 100 sounding rockets a year over the next three years. Actually, in later years the pace of individual launchings may go down somewhat rather than increase, as we place in service the new, large, complex and exceedingly expensive vehicles such as SATURN and its successors, each of which will have the payload capability of several of its predecessors.

I would like to summarize then by simply saying that I feel we are embarked upon a broad, technically sound and logical program with definite goals in mind - our own goals. We are undoubtedly going to have our share of failures in this

program - as you in this audience know so well, they have to be expected in this kind of work - and we will undoubtedly have to adjust the detailed timing and content of the program as we move along and learn more. But we do have a plan, we are getting good support from both the Administration and Congress, and I feel from my short experience with NASA that we have outstandingly competent people at all levels of the organization to supervise the program.

We were awfully late in getting started, but I feel that we are now off and running. This is not a crash program that I am talking about, but it is a vigorous and an aggressive one. My prediction is that in the long run it is going to prove sounder than a hysterical crash program trying to compete for spectacular propaganda firsts.

NO. 60-192



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: IMMEDIATELY, May 5, 1960

NASA RELEASE NO. 60-193

Memo to the Press:

One of NASA's U-2 research airplanes, in use since 1956 in a continuing program to study gust-meteorological conditions found at high altitude, has been missing since about 9 o'clock Sunday morning, (local time) when its pilot reported he was having oxygen difficulties over the Lake Van, Turkey area.

The airplane had taken off from Incirlik Air Base, Turkey. The flight plan called for the first check point to be at 37 degrees, 25 minutes, North; 41 degrees, 23 minutes, East, and for a left turn to be made to the Lake Van beacon, thence to the Trabazon beacon, thence to Antalya, and return to Adana. The flight scheduled was estimated at 3 hours, 45 minutes, for a total of 1400 nautical miles. Takeoff was at 8 a.m. local time.

(The above-given times are the equivalent of 3 a.m. Sunday, and 2 a.m., Eastern Daylight Time.)

About one hour after takeoff, the pilot reported difficulties with his oxygen equipment. Using emergency radio frequency, he reported he was heading for the Lake Van beacon to get his bearings, and that he would return to Adana.

N.A.S.A. PERMANENT
HISTORICAL FILE

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As indicated above, his flight plan called for him to make a left turn at the Lake Van beacon. His last report indicated he was attempting to receive that beacon. It is believed he probably was on a northeasterly course, but there was no further word.

An aerial search was begun soon after receipt of the last communication. The Lake Van area is mountainous and very rugged. No evidence has been sighted of the aircraft having crashed.

If the pilot continued to suffer lack of oxygen, the path of the airplane from the last reported position would be impossible to determine. If the airplane was on automatic pilot, it is likely it would have continued along its north-easterly course.

The pilot, as are all pilots used on NASA's program of upper atmosphere research with the U-2 airplane, is a civilian employed by the Lockheed Aircraft Corporation, builders of the airplane.

When the research program was begun in 1956 by the National Advisory Committee for Aeronautics (predecessor to NASA), the federal agency did not have a sufficient number of pilots to operate the program, and so a contract was made with Lockheed to provide the pilots.

Overseas logistic support for NASA's continuing use of the U-2 is provided by Air Weather Service units of the USAF.

NASA has procured a total of 10 U-2 airplanes. The airplane was originally built as a private venture by Lockheed to serve as a "flying test bed". It is powered by a single Pratt & Whitney J-57 turbojet engine, and can maintain flight for as long as four hours at altitudes of up to 55,000 feet.

Since inception of the research program in 1956, the U-2 flying weather laboratories have operated from bases in California, New York, Alaska, England, Germany, Turkey, Pakistan, Japan, Okinawa and the Philippines.

The U-2 airplanes are presently being used in California (Edwards AFB, one), Japan (Atsugi, three) and Turkey (Adana, four).

The instrumentation carried by the U-2 permits obtaining more precise information about clear air turbulence, convective clouds, wind shear, the jet stream, and such widespread weather patterns as typhoons. The airplane also has been used by NASA to obtain information about cosmic rays, and the concentration of certain elements in the atmosphere, including ozone and water vapor.

Instrumentation carried includes: Angular velocity recorder, to measure the airplane's rate of pitch; modified VGH recorder, to measure and record head-on gust components in flight; flight recorder Model BB, continuous recorder of indicated airspeed, pressure altitude and normal acceleration; airspeed and altitude transducer to measure pressure altitude and indicated airspeed;

temperature and humidity measuring set AN/AMQ 7, to measure indicated free air temperature and indicated relative humidity; and vortex thermometer system, to measure true free-air temperature within one-half degree Centigrade at high speeds.

END

Release No. 60-193



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: HOLD UNTIL LAUNCH

RELEASE NO. 60-186

PROJECT ECHO PAYLOAD AND EXPERIMENT

On today's launch from the Atlantic Missile Range the United States will attempt to place a 100-foot-diameter inflatable sphere into a circular, 1000-mile-altitude orbit. This launching marks the first attempt to place a very large inflatable structure in orbit, and to use this structure as a reflector for a series of passive communications satellite experiments. It also marks the first use of the Delta three stage rocket.

The sphere was fabricated of DuPont Mylar Polyester film, $\frac{1}{2}$ mil (.0005 inches) thick, about half the thickness of the cellophane on a cigaret package. The satellite's shell is covered with vapor-deposited aluminum to provide radio wave reflectivity of 98%, up to frequencies of 20,000 mc.

Satellite weight breakdown is: plastic sphere - 132 pounds; aluminium covering - 4 pounds; sublimating powder (to provide inflation)- 30 pounds. The container which carries the sphere into orbit weighs 24 pounds; the Delta third-stage casing which will follow the sphere into orbit weighs about 50 pounds.

The sphere will be launched in a southeasterly direction so that the orbital plane will be inclined about 47 degrees from the equator. Traveling about 16,000 miles per hour, the satellite will circle the Earth about once every two hours. The belt

covered by the orbiting satellite will extend 47 degrees north and south of the equator. During twilight and evening the sphere will be as visible as a zero magnitude star, about as bright as the star Vega.

Today's launching, the first in a series of Project Echo experiments, is part of a long-range program designed to investigate the feasibility of global communications systems using satellites.

One of the primary missions of the national space program is to develop the necessary technology to enable scientists to channel the knowledge they are gaining about space and space vehicles into areas directly benefiting mankind. One of the "practical applications" of space research is in the field of communications.

During the last few years, it has been increasingly apparent that communications lines were becoming overcrowded. Telephone and telegraph lines are barely able to keep up with the demand. Future demands on trans-oceanic telephone cables which are already carrying a heavy burden, will continue to grow. Worldwide TV transmission is still not a reality.

Although scientists aren't predicting the end of telephone and TV transmission as we know it today, they do think that earth satellites will someday provide a much greater capability for global communications. Experimentation in this direction will one day lead to worldwide TV, for instance. In the years to come, communications satellites might also serve as relay stations for messages to and from space vehicles.

The NASA's communications program is directed toward determining the optimum systems for various applications and the technology from which such system can be engineered. Investigation of a passive reflector communications system, in which radio signals (including voice-modulated signals) can be bounced from one point on Earth to another via a satellite, is the first step in the program. The first experiment in this investigation is Project Echo.

John R. Pierce, of Bell Telephone Laboratories, has been credited with the first concrete recommendation of the use of artificial Earth satellites as communications links. His technical paper was published in 1955. Appropriately Bell Telephone Laboratories, under contract to NASA, has joined with the NASA Jet Propulsion Laboratory to perform a major role in the Echo project.

Although Project Echo is an experiment directed by NASA, independent researchers in the communications field the world over have been invited to engage in experiments of their own. The 100-foot sphere has, in effect, become a worldwide laboratory tool. In this regard, NASA is assisting all of these interested experimenters in the performance of their own experiments by providing tracking data.

The payload was developed under the direction of William J. O'Sullivan, Head of the Space Vehicles Group in the Applied Materials and Physics Division, at NASA's Langley Research Center. The satellite is made of 82 separate flat gores of Mylar previously covered with a thin coating of vapor-deposited aluminum. These gores are fitted and cemented together to form

the sphere. Fabrication of the sphere was the responsibility of G. T. Schjeldahl Company, Northfield, Minnesota, The National Metallizing Division of Standard Packaging Corp., Trenton, New Jersey, was responsible for the aluminum covering.

Before launching, about 30 pounds of sublimating powders are inserted in the sphere. It is then folded accordian-fashion and placed inside a $26\frac{1}{2}$ -inch-diameter magnesium container which will carry it into orbit. (Kaiser-Fleetwings, Inc., Bristol, Pa., made the container.) Both sphere and container are pumped almost entirely free of air to decrease inflation rate at altitude.

The satellite carries no instrumentation. It will be tracked optically and by radar. The third stage of the Delta vehicle, however, is equipped with a telemetry package. The third-stage casing will follow the satellite closely during the first few orbits. The telemetry signals (108.06 mc) will be useful in determining the sphere's initial orbit. These signals will also show payload separation from third stage which should occur shortly after injection into orbit.

About two minutes after the payload is injected into orbit, the magnesium container will be split open by an explosive charge placed around its middle. The inflatable sphere is released from its container and gradually begins to inflate with the expansion of the small amount of residual air left inside. Thirty pounds of sublimating powders cause additional inflation: 10 pounds of benzoic acid provide the initial expansion and 20 pounds of anthraquinone provide for sustained inflation.

There are two primary stations taking part in the Project Echo communications experiment: Bell Telephone Laboratories' facility at Holmdel, New Jersey, and the NASA-Jet Propulsion Laboratory's Goldstone station in California. Radio signals will be bounced between the East and West Coasts of the U.S. via the orbiting satellite.

Following radar acquisition of the satellite and establishment of accurate orbit, voice modulation transmission will be attempted using frequency modulation (FM) techniques.

During the experiment, BTL will transmit on a frequency of 960 mc/s for reception at Goldstone. JPL will transmit a 2390 mc/s signal to BTL on the East Coast. Equipment at Goldstone includes two 85-foot-diameter paraboloid antennas -- one a receiver and the other a transmitter. BTL will transmit with a 60-foot dish and will receive with a special horn-reflector antenna. This antenna, which looks generally like the scoop of a steam shovel, is a recent development designed to cut down radio noise interference. This antenna is in the final stages of development and may not yet be operative during the first Echo experiment. If this is the case, BTL will transmit only.

Since JPL is a primary source of tracking, NASA will not try a communications experiment until a good orbit has been established. Once accurate orbital elements have been obtained, signals will be bounced between the East and West Coasts.

Communications equipments of both JPL and BTL have been exercised by bouncing signals off the moon. JPL also has exercised its equipment by tracking the Tiros I meteorological satellite.

The next opportunity for setting up a successful communications link will be during orbit number nine, about 18 hours after launch when the satellite will be mutually "visible" to equipment at both stations for about 10 minutes.

Here is a description of the operations involved in the communications experiment:

The NASA Goddard Space Flight Computing Center will send orbital calculations to JPL and BTL. These orbital data will be used to position the receiving and transmitting equipment. The transmitting antenna is "slaved" to the receiving antenna at each site so that the satellite will be "illuminated" by radio waves. Following acquisition at Goldstone, its transmitter and receiver can be used as a self-tracking radar system. An optical boresight system which can be used when visibility conditions exist will assist the trackers in satellite acquisition.

To set up a communication link, BTL will illuminate the sphere with a 960 mc/s signal. This signal will bounce off the satellite in all directions. A portion of the scattered energy will be picked up by the Goldstone station where the receiver is pointed toward the satellite. To complete the communication link, Goldstone will transmit in the same manner a 2390 mc/s signal for reception at BTL. Transmitted power will average about 10 kw.

The time of mutual visibility between the East and West Coasts for any one pass of the sphere is not expected to exceed 16 minutes. Scientist estimate that in order to obtain intelligible communication, the satellite will have to be no

farther than 3000 miles away from either ground station.

The sphere will be in continuous sunlight for about two weeks. After this time, the satellite's orbit and the Earth's rotation around the sun will be such that the sphere will be in the Earth's shadow.

Sunlight plays an important part in maintaining the sphere's shape. The sublimating powders turn into gas at temperatures slightly above freezing. Unless in sunlight, the temperature of the satellite will be well below freezing. In continuous sunlight the sphere's temperature will average about 239 degrees F.

Once out of sunlight, gases used to keep the satellite inflated will return to a solid state. Scientists are interested to learn if and in what form the satellite will re-inflate when returning to sunlight. There is a question as to the amount of sublimating powders remaining after two weeks. Some will have seeped out through whatever punctures exist from micrometeorites. Unless the satellite returns to its spherical shape, it will not be useful for communications experiments because of the non-uniformity of reflected signals from a misshapen surface.

The internal satellite pressure at altitude will be about .00004 pounds per square inch. Scientists estimate that this pressure is at least 25,000 times the pressure due to solar radiation and air drag.

The Echo satellite, with a surface of 31,000 square feet, is a large, lightweight structure as opposed to the Earth satellites with higher densities which have been launched before. The

effects of air drag and solar radiation on a three-foot metal payload of the same weight as Echo would be negligible. These forces will, however, influence the velocity and orbit of the 100-foot sphere. Scientists will be interested to find out how much. This can be done by comparing orbital data of the sphere with the Delta third-stage casing.

What effect will micrometeorite impact have on the sphere? Scientists predict that under expected conditions the sphere will remain physically usable as a reflector for at least a week, but more probably at least two. Even a week's lifetime would be extremely valuable to the communications experimenters. Despite a number of space experiments concerning micrometeorite impact, the status of technical knowledge of their number, size, energy, and size of hole they produce is in an early stage of evolution. The Echo experiment should add to the fund of knowledge now building on the subject.

The 100-foot inflatable sphere has undergone a number of pre-orbital flight tests under the supervision of the Langley Research Center. General Mills, Inc., Minneapolis, Minn., took part in the initial development of this type of inflatable structure. These suborbital launches from NASA's Wallops Station on Virginia's eastern shore began October 28, 1959. These shots were used to test the inflation and ejection techniques of the Echo sphere. This type of testing is part of a NASA program aimed at research on advanced inflatable space structures. These suborbital launches will continue.

In addition to the suborbital shot last October in which the sphere attained an altitude of 250 miles and distance out over the Atlantic of 500 miles, other launches were: January 16, up 250 miles and out 490 miles; February 27, up 225 miles and out 540 miles; and April 1, up 200 miles and out 570 miles.

Leonard Jaffe is NASA's Chief of Communications Satellite Programs. Robert J. Mackey, Jr. NASA's Goddard Space Flight Center, is Echo Project Manager. Echo Project director for Bell Telephone Laboratories is William Jakes. W. K. Victor is project director for the Jet Propulsion Laboratory.

-END-

LAUNCH VEHICLE

This is the first launch of the Delta vehicle.

It comes just a little more than a year after NASA signed a contract with Douglas Aircraft Company, Inc., for its development. The \$24 million contract, signed in late April 1959, called for production and development of 12 Deltas to be used for a variety of satellite and deep space missions during 1960 and 1961.

The Delta would be what NASA Administrator T. Keith Glennan called "a much needed interim vehicle" for use until more powerful launch vehicles are ready.

The contract was the first that NASA signed directly with industry for development of launch vehicles. With other vehicles, originated in the Department of Defense and later assigned to NASA, contract management is conducted for NASA by a military agency. This is true in the case of the U. S. Air Force Ballistic Missile Division for Atlas-Ables and Thor-Ables and of the U.S. Army Ballistic Missile Agency for Juno II's.

The Delta stands 92 feet high and has a maximum diameter of eight feet. Its fueled weight on the pad is a little less than 112,000 pounds. Its ^{first-stage} Rocketdyne/engine develops 150,000 pounds thrust.

In configuration, Delta is similar to Thor-Able. New features in Delta are an improved autopilot and radio guidance system for first and second stage powered flight and precise attitude control for the longer coast period between second stage burnout and third stage ignition.

The first stage of Delta is a Douglas SM-75 Thor intermediate ballistic missile without the Thor guidance system and with adaptor to receive the second stage. The first stage weighs about 100,000 pounds fueled and has a thrust of approximately 150,000 pounds. It is propelled by liquid oxygen and kerosene.

The second stage is an Aerojet-General AJ10-118 liquid engine which was modified from the second stage of Vanguard and Thor-Able vehicles. It weighs more than 4,000 pounds and develops a thrust of about 7,500 pounds. The stage, packaged by Douglas, also contains a guidance compartment for the Bell Telephone Laboratories radio guidance system.

The third stage is an Allegany Ballistics Laboratory ABL-248 solid propellant rocket also originated for the Vanguard and Thor-Able. It weighs more than 500 pounds including propellant and produces a thrust of about 3,000 pounds. In the stage, also built by Douglas, the ABL-248 motor is mounted on a spin table.

In the firing sequence, the Thor first stage provides about 160 seconds of powered flight during which the rocket is guided by the Bell Telephone Laboratories Guidance System and roll and pitch programmers. At burnout of the Thor, it separates and re-enters the atmosphere.

The second stage ignites almost immediately after first stage cut-off. After 20 seconds of powered flight the nose fairing which protected the payload and third stage during launch is jettisoned. The second stage fires for about 115 seconds also being steered by the BTL guidance system.

After the second stage is commanded off, the vehicle coasts for about 15 minutes with the second stage still attached. During this period, the vehicle and payload coasts some 800 miles up into space and about 2300 miles down range. Its attitude is controlled during coast.

After coast, in rapid sequence, the third stage is spun up to 120 rpm by small spin rockets to stabilize its flight, the third stage ignites, and the second stage is separated by explosive bolts. The third stage fires for about 40 seconds achieving orbital velocity of about 16,000 miles per hour.

After third stage burnout, de-spin rockets slow the rotation. The empty third stage casing, weighing about 50 pounds, is separated from the payload by a spring which retards its velocity and is tumbled by a lateral rocket so it will not interfere with the payload.

A telemetry transmitter weighing 15 pounds is mounted on an instrument rack on top of the third stage motor just below the payload separation band. Four poles of the turnstile antenna are folded down over the third stage motor until the fairing is jettisoned.

The transmitter will operate at a frequency of 108.06 MC continuously for about six to ten days so that the third stage casing can be tracked. Its power is 60 milliwatts. The third stage is expected to remain in orbit near enough to the inflated sphere long enough so that accurate optical fixes on the sphere can be obtained.

- 4 -

NASA Headquarters Delta Project Manager is Vincent L. Johnson.
Head of the Goddard Space Flight Center Field Projects Branch at
the Atlantic Missile Range is Robert Gray.

Douglas Aircraft Manager at AMR is Bill E. Stitt.

- END -

PROJECT ECHO
TRACKING

Tracking during the Project Echo experiment is under the overall direction of NASA's Goddard Space Flight Center. Tracking services for the NASA experiment will be provided by: Bell Telephone Laboratories' station, Cape Canaveral, Fla.; the Air Force's radar test site in Trinidad, B.W.I., operated by the Rome (New York) Air Development Center; the NASA-Jet Propulsion Laboratory's Goldstone station, Camp Irwin, Calif.; Lincoln Laboratory's Millstone Hill radar station, Westford, Mass.; NASA's Minitrack network; and optical tracking stations operated for NASA by the Smithsonian Astrophysical Observatory, Cambridge, Mass.

BTL's guidance radar at Canaveral will provide initial trajectory data. During the launch phase, Trinidad will track the Delta third-stage which carries a beacon transmitting on 108.06 mc with a power output of 60 mw. After payload separation, Trinidad will "skin track" the payload by radar to observe inflation of the 100-foot sphere. Tracking data from both sites will be transmitted to Goddard's Computing Center for a rough determination of the sphere's initial orbit. These orbital computations will immediately be sent out to the other stations taking part in the Echo project.

Goldstone and Millstone will track the sphere during those passes when it comes within radar contact.

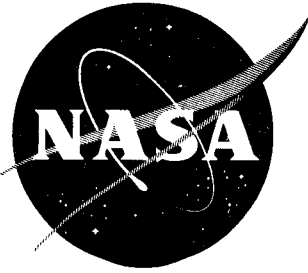
The Minitrack stations will track the instrumented Delta third stage. Since the third-stage casing will follow closely behind the

100-foot satellite during the initial orbits, tracking data from these stations will be useful in determining the Echo sphere's orbit. Minitrack stations are located at: Antigua, B.W.I.; Antofagasta, Chile; Blossom Point, Md.; Lima, Peru; Quito, Ecuador; Santiago, Chile; Woomera, Australia; Johannesburg, South Africa; San Diego, Calif.; and Fort Meyers, Fla.

Because the 100-foot sphere carries no instrumentation, optical tracking figures importantly in the experiment. The Smithsonian operates 12 stations equipped with satellite tracking Baker-Nunn cameras. These are located at: Organ Pass, N.M.; Olifantsfontein, South Africa; Woomera, Australia; San Fernando, Spain; Tokyo, Japan; Naini Tal, India; Arequipa, Peru; Shiras, Iran; Curacao, N.W.I.; Jupiter, Fla; Villa Dolores, Argentina; and Maui, Hawaii. In addition, 45 "Moonwatch" teams around the world, composed of amateur optical trackers reporting to the Smithsonian Astrophysical Observatory, will assist in tracking.

Data from all tracking stations will be transmitted to Goddard where the sphere's orbit will be continually re-evaluated. Goddard's Computing Center will send current orbital data to all stations taking part in the project.

A number of independent groups are expected to track the sphere in connection with their own communications experiments. The Goddard Space Flight Center will provide these independent experimenters orbital information as soon as it is accurately determined.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

RELEASE NO. 60-194

FOR RELEASE: May 8, 1960
1 p.m. EDT

PIONEER V 150-WATT TRANSMITTER TURNED ON AT 8 MILLION MILES

The powerful 150-watt transmitter aboard the United States interplanetary spacecraft Pioneer V was commanded on for the first time at 5:04 a.m. EDT today and worked satisfactorily.

It was a good clear transmission, lasting about a minute and a half.

The command signal was sent from the 250-foot radio telescope at Manchester, England, when the spacecraft was some 8,001,000 miles from Earth. About one and a half minutes later -- the time it took the signal to travel to the spacecraft and the probe's response to return to Earth -- Manchester received the first 150-watt transmission.

"This is truly an historic event and yet quite in character with the other accomplishments of this amazing spacecraft," said NASA Administrator T. Keith Glennan. "We are certain that the world's scientific community shares our elation over this new success of Pioneer V.

"To our British colleagues at Manchester, directed by Prof. Lovell, we extend our hearty congratulations on their magnificent tracking-communications achievement.

"Our congratulations also go to the many, many contractors involved in this interplanetary experiment. A special pat on the

back is due the Space Technology Laboratories, Inc., for an outstanding job of payload packaging and tracking."

Since launch at Cape Canaveral, Fla., March 11, the 94.8-pound probe has been telemetering to Earth scientific information daily via a five-watt transmitter. Early Saturday when it was apparent that the five-watt unit had nearly reached its transmission limit, it was decided to attempt to energize the 150-watt transmitter, believed to be the largest ever operated in space.

This called for a three-step sequence. First a signal was sent to the spacecraft from Manchester at 5 a.m. yesterday which put power into tube filaments through a current-limiting resistor, thereby warming the filaments for about a minute.

At 11 a.m. EDT yesterday, the first step was repeated and a second command was sent which removed the current-limiting resistor and supplied full filament heating for several minutes. The circuit passed both tests successfully.

Finally, at 5:03 a.m. EDT this morning, Manchester sent the final command in the three-part sequence. This energized the 150-watt transmitter as well as an electric converter serving it, both of which had remained idle in the "hard" vacuum of space since launch, undergoing constant radiation.

The 150-watt unit measures about seven by five inches and consists of two amplifier tubes -- about the size of those found in most household radios -- along with capacitors, coils and resistors. The entire package weighs five pounds.

Because of the enormous power drain imposed on the system by the 150-watt unit, the big transmitter is being operated only about two to three minutes every six to eight hours.

Manchester can now receive data at the rate of either 8 or 64 bits per second. For the past few weeks, Manchester and the 60-foot South Point, Hawaii, tracking dish have been operating at only one bit per second owing to multi-million-mile distances and the weakening signal strength. Hawaii will continue to command the spacecraft at a rate of one bit per second.

Power for the probe comes from 4800 solar cells in four arms jutting from the 26-inch spherical package.

The solar cell output constantly charges 28 chemical batteries, the size and shape of standard flashlight batteries only a great deal more powerful. These in turn power more than 40 pounds of experiments, electronics, a receiver, transmitters and associated logic units.

At this time it is impossible to predict how long the spacecraft will continue to relay information. In recent weeks, a minor component failure has been noted and compensated for. Also some slight deterioration in the batteries has been observed, possibly the result of leakage in the vacuum of space.

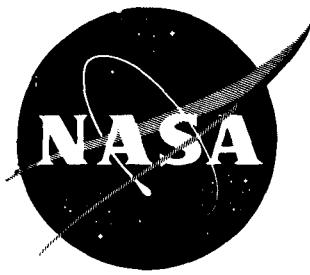
By any measure, however, the probe has stamped itself a true pioneer of interplanetary space.

To date the probe has returned more than 109 hours of data on cosmic radiation, charged particle energies and magnetic field phenomena. In two short months, the probe has overturned well entrenched theories about solar flare effects and the extent of the Earth's magnetic field.

- 4 -

The probe was launched under the direction of the National Aeronautics and Space Administration with executive management supplied by the Air Force Ballistic Missile Division (ARDC).

- END -



NEWS RELEASE

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FOR RELEASE: After Launch No. 60-187

MAY 9 1960

The National Aeronautics and Space Administration conducted a test flight with the first production version of the Project Mercury capsule at 5pm EDT today at Wallops Station, Virginia, in a simulated off-the-pad escape from a booster.

The capsule, the first to be delivered by McDonnell Aircraft Corporation, prime contractor to NASA for the capsules, was tested primarily to demonstrate the capability of the capsule and escape system, landing system and post landing equipment.

Attached to an adapter by means of a clamp ring, the capsule was mounted on a support fixture to simulate a launch vehicle. The clamp ring was released by explosive bolts, allowing the escape system rocket to carry the capsule to an altitude of approximately 2400 feet.

Two seconds after the escape system tower was jettisoned by explosive bolts, a drogue parachute was deployed to aid in stabilizing the capsule. Two seconds later the main parachute was deployed and the capsule landed in the Atlantic Ocean about 3/4 mi off the island launching site. The capsule was recovered by a helicopter of the Marine Air Group 26, New River, N. C., and returned to Wallops Island. Other units of the U. S. Navy Project Mercury Recovery Force in the test were the USS Recoverer (ARS-43) and an underwater demolition team.

The capsule will be returned to the McDonnell Company plant in St. Louis, Missouri, for extensive examination and analysis to verify proper functioning of the capsule and its systems.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington 25, D. C.

The Project Mercury capsule used in today's test was delivered by McDonnell Aircraft Corporation to the National Aeronautics and Space Administration on April 2, 1960.

The capsule, which stands 9 feet high and has a base diameter of 6 feet, was taken by cargo plane from the McDonnell ramp at Lambert-Saint Louis Municipal Airport to the NASA facility at Chincoteague, Virginia. From there it was transported by truck to the test launch area at Wallops Station.

Since its arrival at Wallops Station, NASA and McDonnell engineers have been conducting an extensive series of checkouts on the capsule components.

Today's test with the McDonnell capsule is a continuation of an extensive research and development program to investigate man's capabilities in space. NASA has used small and full-scale models in wind tunnel, airplane drop and Little Joe and Big Joe rocket-boosted flight tests. Future tests with the McDonnell-produced capsules will be made to fully qualify the vehicle under all conditions which can be anticipated in orbital missions. Little Joe, Redstone and Atlas boosters will be used to launch the Mercury capsules on varying trajectories, culminating in manned orbital space flight.

Delivery of the first of twenty Mercury capsules on order was accomplished less than 14 months after the contract to McDonnell Aircraft was signed on February 8, 1959.

Later capsules are designed to be launched to an altitude of over 100 miles, travel at a speed of 17,400 miles per hour, withstand reentry heating, and land safely in a designated area in the Atlantic Ocean after three 90-minute orbits around the earth.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
1520 H STREET, NORTHWEST · WASHINGTON 25, D. C.
TELEPHONES: DUDLEY 2-6325 · EXECUTIVE 3-3260

FOR RELEASE: IMMEDIATELY, May 11, 1960

Release No. 60-195

TIROS TIMER RESUMES OPERATION

The timing mechanism which controls remote operation of the narrow angle camera on the Tiros I satellite resumed operation last night (May 10) after having failed to respond to commands since April 2.

The clock device permits scientists to program areas over which the narrow angle - high resolution - camera is to photograph cloud cover. It commands a tape recorder to store photographs for later transmission to a receiving station. During the period the timer was inoperative, use of the high resolution camera had been limited to direct commands near the Fort Monmouth, New Jersey and Kaena Point, Hawaii, stations.

A possible explanation of the behavior of the device is that a small joint in the wiring opened at low temperature, breaking a contact. "Soaking" in sunlight may have closed the joint, re-establishing contact.

If such were the case, continued exposure to low temperatures may result in a recurrence of loss of contact until heat from the sun again closes the opening.

- 2 -

Since the timer went out, continued attempts had been made to reactivate it. On the 572nd orbit last night, the command procedure from Fort Monmouth was conducted, and programmed pictures were received on the next orbit. They were of the Pacific Ocean. The procedure was repeated for the five orbits subsequent with the same successful results.

The timer for the wide angle, or low resolution, camera has been functioning properly since Tiros I was launched April 1.

END

Release: 2:15 EDT, May 11, 1960

PROJECT ECHO LAUNCH RESCHEDULED

The attempted launch of a 100-foot inflatable sphere as a passive communications satellite has been rescheduled for May 12, 1960. The launch of Project Echo originally was scheduled for May 5th but had to be postponed because of technical difficulties in the second stage of the Delta vehicle.

The date of the Echo launch has been made public in advance of launch to allow volunteer project participants adequate time for preparations.

Note on original: Phoned to Glen Wilson & John Carstarphen 5-11-60 at 3:00pm.

Copy of light original

STATEMENT FOR THE PRESS

May 13, 1960
10:00 am EDT

The passive communications satellite launched this morning by NASA did not achieve desired orbit because of a failure in performance of the launch vehicle.

The vehicle was to have carried a 100-foot inflatable sphere into a 1,000 mile orbit, where ground stations were to bounce signals between the east and west coasts in communications experiments.

First and second stages of the three-stage Delta launch vehicle apparently performed as planned. Telemetry data indicate that about halfway through the vehicle's coast period the attitude control jets in the second stage failed. If this were the case, the vehicle could not have maintained the angle to place the payload in the programmed orbit.

At this time, there is no precise information on whether or not the sphere inflated, nor whether or not it is in orbit. The only means of confirming are visual and radio sightings.

Copy of faded original.

"REPORT FROM OUTER SPACE"

WORLD WIDE 60

N B C TELEVISION NETWORK

MAY 14, 1960

9:30 - 10:30 P.M. EDT

Producer: Robert G. Abernethy
Director: Ralph Howard Peterson
Consultant: Robert Northshield

Guests: T. Keith Glennan
Otto Struve
William Howells
Frank Drake
Robert Jastrow
D. D. Wyatt

NBC Reporters: Frank McGee
David Brinkley
Peter Hackes
Bob Abernethy

N B C NEWS PRESENTS
REPORT FROM OUTER SPACE

MR. MC GEE: The sound you hear is the sound of space. It was collected in the quiet West Virginia hills, near Green Bank...at the National Radio Astronomy Observatory.

One of the projects now underway at Green Bank is nothing less than listening for signals from other intelligent life, on other planets, a report from outer space.

ANNOUNCER: N B C Television presents WORLD WIDE 60 (pause) tonight Report From Outer Space.

MR. MC GEE: The Space Age is not yet three years old, but already, things that were fantasy just yesterday are suddenly facts today.

This is a report on why the United States is exploring space, and what difference it makes.

The report begins here in Washington in just a moment with David Brinkley's impression of life in the age of space. (Commercial Billboard)

MR. BRINKLEY: Since the Stone Age we have named each period in man's history for its dominant element or discovery. The Stone Age, and Iron and Bronze. But lately we've been declaring ourselves to be in a new age long before we've learned to live in the old one.

We were not yet entirely happy with the Air Age when we moved into the Atomic. And we certainly had not learned what to do with that one when we came into --(Or were dragged kicking and screaming into)-- the Age of Space.

Now that we're in it, what is it and where are we? Nobody really knows, but we do know that in ways that are subtle or obvious, superficial or profound, it is changing our lives.

We know that not since the Greek and Roman Empires have the names from their mythology fallen so lightly from so many tongues and headlines. Mercury, Atlas, Nike, Zeus, Juno and Titan.

Anyone as old as, say forty, can remember when children playing airplane shouted, "Contact." More recently, "Roger, over." But now, everywhere, it's the familiar countdown.

Thousands of people and billions of dollars doing jobs that ten years ago did not exist. Some of this is seen best in Southern California, where Roy Neal is waiting to show us around.

MR. NEAL: I live in California's San Fernando Valley. At the far end...twenty miles away...they test rocket engines and rattle the windows of my home in the process. It's enough to remind me and my neighbors that the Age of Space is upon us.

We are surrounded by much of its business...which has changed to the degree of placing heavier emphasis on white collar workers than on Rosie the riveter. Drawing board workers far outnumber the production line.

The companies...many of them...are the same that grew big in Rosie's time building aircraft. Some have even kept the same names...call themselves airplane companies while building missiles and space vehicles. Others have added astronautic divisions or missile and space divisions. And around their newer factories whole new neighborhoods have grown.

About 40 percent of the industry is concentrated in the Far West...so 3 times a week there's a chartered passenger plane flying civilians and air force alike round trip shuttle...LA to Cape Canaveral. And the second main line of travel finds a preponderance of passengers on the Los Angeles Washington Jets carrying brief cases that identify them with the businesses of space. And for the story of the space age in Washington, here is Peter Hackes.

MR. HACKES: Here in Washington, you can't have a project without an agency. And you can't have an agency without initials. So it was inevitable, I suppose, when the Space Age dawned, that Washington have a thing called N-A-S-A -- that's Nasa...which stands for the National Aeronautics and Space Administration. It was born in October of 1958... already it's the 5th largest executive agency...as of now has more than sixteen thousand people on its payroll...twelve scientific research centers around the country...and a yearly budget of nearly a billion dollars.

From all over the country come thousands of letters to Nasa: a woman "volunteers" her husband for a future space flight;...children have offered to go -- some have even enclosed letters of consent from their parents....each day brings blueprints and schemes for weird space-flight contraptions (and each one is looked into);...a woman in New Jersey claims she hears strange things on her hearing aid every time Nasa fires a space shot at Cape Canaveral;...and a bowling team at the Library of Congress is called the Satellites--and incidentally it leads the league.

Why all the interest? Why are we putting so much money, time and attention into what's "out there"? The reasons, in just a moment.
(Commercial)

The first question to be asked about space research is, "Why?" Why is the United States spending nearly a billion dollars a year to explore space. Several experts are here to help us give the answers. First...Dr. T. Keith Glennan, head of the National Aeronautics and Space Administration.

DR. GLENNAN: Space is the greatest new frontier to be breached by man in over four hundred years. Not to explore it, now that the means seem to be at hand, would be unthinkable. Backing away from this

or opportunity would be a denial of our heritage of seeking constantly to acquire new knowledge to be applied by mankind for beneficial purposes.

MR. HACKES: Mr. D. D. Wyatt, Assistant Director of Space Flight Programs, NASA.

MR. WYATT: It is impossible to foresee all the practical benefits of space research or of any kind of research. But we know that there will be rewards. There always have been. All exploration of all new frontiers since history began has led to increases in the world's standard of living. This is how we rise from the dust.

MR. HACKES: Dr. William Howells, Professor of Anthropology at Harvard.

DR. HOWELLS: It would be rather interesting to find out for sure whether there are other creatures on other planets, and if so, whether they are anything like us.

MR. HACKES: Dr. Robert Jastrow, one of NASA's top physicists, and one of those planning what to do on the moon.

DR. JASTROW: We have three principal scientific purposes. One, as Dr. Howells suggests, is the search for other life. Another is to uncover the history of the solar system and the universe. The third is to find out all we can about the sun, and how it controls events on earth, because everything on earth is dependent on the sun.

MR. BRINKLEY: Devotion to science may be a very real reason for space exploration----to the scientist. But some of us wonder how much space research we would be going if it were not for Russia, Dr. Glennan

DR. GLENNAN: Among the many areas of competition between our way of life and that of the Soviet Union, space exploration is the most visible, the most exciting, and the one in which the Soviet Union continues to enjoy a propaganda advantage.

It is reasonable to believe that a substantial part of the money being voted by the Congress for the nations program in space exploration is given to us because of our competition in this field with the Soviet Union.

What we are doing is determined by our scientists and engineers, in fulfillment of our stated mission. But the pace at which we are moving and the amount we are spending on this program is determined by the competition and the urgency with which this nation views this task.

I would like to knock down one or two misconceptions. We are not exploring space because we hope to colonize other planets. We are not expecting to find rare minerals.

I also believe it is a mistake to think that space is going to be of great use for military bases. We can do much better with the intercontinental ballistic missiles we already have. On the otherhand, meteorological, communications, early warning, and reconnaissance satellite systems will be useful to the military, in my opinion.

MR. HACKES: The space program began to pay off for the scientists with the first satellite sent up. This year, we have begun to see the possibility of dollars and cents returns for the rest of us.

We asked Mr. Wyatt for a report.

MR. WYATT: We have no idea of all we are going to learn, and what it will all mean. We can be certain that we will learn of things about which now we can not even dream. As a matter of fact, we have already had some surprises.

It is useful to remember that when Columbus set out on his famous trip he was looking for India.

Since January thirty-first, nineteen fifty-eight, we have launched twenty-one experiments. Eight are in orbit around the earth, two around the sun. Five are still talking to us.

One of the most significant practical results of our research so far has been the promise of better understanding of our weather. The truth is that we do not really know why the weather occurs as it does. We do not understand the basic mechanism.

But now we have Tiros, our weather satellite, sending us pictures of the clouds from above.

This is the cloud picture that was received for instance, in one pass over Western Europe. By the way this is the size of the camera that took those pictures, somewhat smaller than the ones we are using on this program.

We know that radiation from the sun might affect our weather just as it causes occasional radio interference, and the northern lights. Our satellites are measuring this solar radiation and radioing the information back to us.

When we have continuing news of the weather all over the world and in the upper atmosphere we should be able to improve the accuracy of our forecasts. If we can improve these forecasts we will save billions of dollars a year. We can button up for hurricanes, and get the smudge pots going in Florida in time to offset a cold snap. And think in the future what it could mean for countries depending on an agricultural economy, if we could say in advance, "This is going to be a good year," or "This year there is going to be a drought." We might relieve the hardships and suffering of peoples throughout the world.

Communications and navigation satellites also can make significant advances in our civilization. Our program includes putting a balloon a thousand miles out in space and bounce signals off it from New Jersey to California. The day is not too far off when satellites will be launched to relay telegrams, telephone calls, and live television programs from any part of the world to any other part.

These developments in communications are I think extremely important. They may lead to a better understanding between men of all nations and reduce the likelihood of war. The man you're likely to fight with is the man you don't understand.

Major scientific discoveries have already been made. Two years ago Dr. James Van Allen put Geiger counters in our first Explorer Satellites. The counters revealed two enormous radiation belts around the earth... bands of electrically charged particles trapped by the earth's magnetic field like filings around a magnet.

The exact nature and energy levels of the particles is now under study. We know that these radiation belts are going to be dangerous or at least a nuisance when it comes to putting man into space at heights above 600 miles. Another interesting discovery was related to the shape of the earth. We had always thought that the earth was spherical except for a bulge at the equator. The orbit of the first Vanguard satellite indicates to us that the earth is in fact slightly pear shaped. It is a little humbling to note that Columbus, too, thought the earth was pear shaped.

In the next several years we want to put a telescope into orbit up above the atmosphere where it can observe the whole electromagnetic spectrum coming in to us from the stars. Now we see only the part of it that the atmosphere lets through. We may learn more about the nature and origin of the universe from this than from any other single experiment.

But, again, you can never predict where the payoff will come from any kind of research. All we know is that the rewards have always been greater than the cost.

MR. BRINKLEY: The most glamorous, terrifying, and controversial aspect of the space program now is Project Mercury, the plan to put a man into orbit around the earth and bring him back alive.

Dr. Vannevar Bush, among other distinguished scientists, thinks the Project is a stunt and a waste of money that could be spent much more usefully elsewhere.

Dr. Glennan, this seems as good a time as any. Why are you spending 345 million dollars on this project, to shoot a man around the earth?

DR. GLENNAN: Well, first of all, this is not a stunt. The best piece of scientific apparatus in the world is man. We have not been able to develop a mechanical substitute for the judgment of a human being. Only man can cope with the unexpected. And the unexpected, of course, is the most interesting.

So all of our plans for scientific exploration assume that eventually man will go into space.

The trouble is that although all of us think men can be useful out there, none of us knows for sure.

If men can not perform useful work in space, it is quite possible that the direction of our efforts will have to be changed. So it is important to find out about man's capabilities in space--and soon!

There is only one way to settle this question. Late next year, we hope to put an astronaut into an orbit 120 miles above the earth's surface, let him circle the earth three times and then bring him back safely. We think this will tell us much of what we want to know.

This is the simplest possible way to learn what we need to know, at the earliest possible date.

MR. HACKES: Project Mercury has NASA's highest priority...

Sometime next year, an Atlas missile booster will be fired at Cape Canaveral, with a manned space capsule for its nose cone.

When it reaches a height of about 120 miles, the capsule will go into orbit around the earth.

After three orbital trips--a total of about $4\frac{1}{2}$ hours--small rockets will be fired to slow down the capsule, get it out of orbit, and back into the atmosphere.

Twenty minutes later--dropping underneath a parachute--the first American will return from space, to land in the waters off Cape Canaveral.

What you're seeing is man dipping his toe into space. It's the smallest beginning of a project to send man to the moon--and beyond--then bring him back to tell perhaps the weirdest--most fascinating--story ever told. This rocket called Little Joe is test-firing an empty space capsule...

At a certain height, an escape rocket is fired--separating the capsule from its launching booster. This rocket will be fired if the astronaut gets into any trouble--to get him away from an exploding booster rocket.

This firing was a test of these escape rockets; a test of the parachutes which will lower the capsule into the water when the astronaut returns--also a test of the capsule itself--and how well it will survive the shock of hitting the water. (The capsule is nine feet tall, and six feet wide at the base--shaped something like a television tube. After hitting the water--a smoke bomb is set off, and dye marker is spread which (along with radio signals from the capsule and a flashing light) are to guide a recovery ship to pick it up.

One of these seven young American will become the first U. S.

Astronaut:- Navy Lieutenant Malcolm Carpenter, Air Force Captain Leroy Cooper, Marine Lieutenant Colonel John Glenn, Air Force Captain Virgil Grissom, Navy Lieutenant Commander Walter Shirra, Navy Lieutenant Commander Alan Shepard, Air Force Captain Donald Slayton.

Each of the seven Mercury Astronauts has been fitted for his own individual couch on which he'll be lying during the flight. At this point, none of the seven knows which one will be chosen for the first flight (even the top Mercury officials haven't decided.) It could be any one of the seven. And before the Mercury Program ends, every one of them expects to make at least one flight up and back.

One of the many tests each astronaut must take is to sharpen up his reaction-time. The Astronauts call this--an idiot box. It tests the time it takes to translate the brain's reaction into wrist motion. A delayed reaction to a signal from the ground, or to a capsule emergency indicator, could mean life or death, to a man in space.

Another test--the thermal chamber. It's heated up to 150 degrees by white hot wire coils--to test each man's ability to function--to do good work--in case the temperature controls fail inside the capsule.

Besides the protection of the space capsule, the astronaut will wear a pressure suit, which will feed him oxygen if the cabin system breaks down. This is a test of orientation ability--practice for the Astronaut--in keeping himself on a steady course, even though his surroundings outside seem to be tumbling topsy-turvy. It is also aimed at teaching the astronaut to keep a level head--even when the capsule begins to tumble in space.

One of the toughest parts of the training: riding the centrifuge. As it spins faster, the centrifugal force imitates the tremendous weight

he'll feel when the capsule is launched--up to 15 times the pull of gravity. Inside the cabin, the astronaut responds to signals.

The seven astronauts get their training at many places--some of it in St. Louis at the McDonnell Aircraft Corporation, where the capsules are being made.

Take a good look, gentlemen. One of you will be riding inside it next year...perched on top of an Atlas booster, hurtling into space.... You'll get a first taste of what it's like this fall when you'll ride your capsule out over the Atlantic in the forward end of a Redstone Rocket. Then (perhaps by this time a year from now) the first U. S. Astronaut will look down on earth from his orbiting capsule. From his vantage point, one of the seven men you've just seen will send back information vital to future flights...toward the day when man widens his horizon to the space beyond.

After Project Mercury.....get man to the moon. We'll have a report on this next fascinating step out into space in a moment. (Commercial)

MR. BRINKLEY: Man's first stop in space will be the moon. One of those planning what to do there is Dr. Robert Jastrow, of NASA.

DR. JASTROW: The moon may have the answers to some of the most important questions in science. How was the solar system created? How did it develop and change? Where did life come from?

The particular importance of the moon is that it is the only accessible object that can give us these answers. The reason for this is that the moon has no wind and water to erode its surface, to wear away the record of history, to destroy the cosmic dust that has fallen there for billions of years. The Earth, and Mars and Venus are of no help to us. Their surfaces are all churned up and worn away.

record is gone. The moon is the only nearby place where this record preserved. That is why the moon is so important scientifically. Until get to the moon, all we know about it is what we can see from the earth. think there is a layer of loose rock on top of hard rock farther down. the surface, we think there is probably a foot or so of dust or sand, t we really don't know.

There's a general impression that the surface of the moon is rough d craggy. But more recently, measuring the shadows, we find that, on e whole, the moon's surface is much more gentle. Landing on it will be ke landing on the Sahara desert. No slope is more steep than about n degrees.

With a laboratory and a slow motion camera, you can simulate how the on's craters might have been made by meteorites, millions and billions years ago.

The smallest craters that we can see on the moon are about one le across. They were formed from meteorites which came in about once ery ten thousand years and less often for the larger ones.

Now the interesting thing about the moon's craters is that they are l round and they look just as they did when they were formed.

The earth has probably been hit by just as many meteorites as the on. But here, earthquakes and atmosphere twist and erode the craters they disappear from the surface after about ten million years. But e moon is too small to hold an atmosphere, and probably never had much ter and doesn't show any signs of moonquakes--in fact it doesn't show r signs of disturbance at all. That's why we think the moon's surface ars a long history.

We are going to explore the moon in a sequence of steps. The first what we call a rough landing of instruments. Two weeks ago NASA let

tracts for a package containing a television camera, instruments to measure radioactivity, and other experiments.

We hope to send up these instruments within two years.

We may put instruments in orbit around the moon. Then, later we will make soft landings with more fragile instruments.

As the ultimate in unmanned exploration, we may land instrumentations that can move around. These will be powered by solar batteries. They will rest during the lunar night and then come to life again every two weeks when the sun rises.

The most rewarding phase of lunar exploration will come when men reach the moon. Instruments can only measure what we expect, but a man can find what we weren't looking for, and that is therefore the most valuable. We hope the first manned flight to the moon will take place in about ten years, and the serious scientific work a few years after that.

MR. HACKES: To each of us, understandably and quite properly, our moon seems to be the most important moon, our planet the only important planet, our sun the only star that matters and our solar system just about all there is.

But there are billions of other stars, other solar systems, other planets. And so there have been billions of chances for life to develop among them just as it has here. In a moment, a report on our search for other life somewhere along the limitless paths of the skies.

(Network Identification)

MR. BRINKLEY: Seen in relation to the universe, the earth is only a speck of dust. And while we who live on it are capable of monumental feats of vanity, the greatest of all is to assume ours is the only planet where anything lives, grows, reproduces itself, and dies.

There must be billions of other planets, and mathematically it is monstrous to assume there is life on only one.

In a clean, remote valley at Green Bank, West Virginia, the National Science Foundation runs a radio astronomy observatory. One thing that goes on here is Project Ozma, named for the Queen of the Land of Oz. A vast, saucer-shaped antenna is turned upward, collecting noises from space -- as a sail is put up to catch the wind. Somewhere, there may be life and intelligence as great or greater than ours, trying to find out something about us as we are about it, maybe with radio signals. Ozma searches for them, signals from the planets around the two stars nearest to us. The sound you hear is what they hear at Green Bank.

Dr. Otto Struve is director of the Observatory, and Dr. Frank Drake runs Project Ozma. They've had a talk with N B C's Bob Abernethy

DR. STRUVE: I remember when I was a student of astronomy a great many years ago it wouldn't have been respectable for a science student to even talk about the possibility of life existing outside the earth. Things are very different at the present time. We are not only talking about life, some form of life on planets in the vicinity of the earth but also about life in the universe.

DR. DRAKE: Yes, I think even three years ago we would have been thought silly to talk about the things we are actually doing today. Since the advent of the Sputnik we have seen some things that seem rather far-fetched are distinct possibilities and we must take such things more seriously.

MR. ABERNETHY: You have been looking for signals for over a month now, Dr. Drake. What have you found?

DR. DRAKE: Well, we have only done about one-quarter of the observing want to do during this first attempt. So far we have not completed ving the absense of any signals above a certain magnitude nor have we ved the existence of any signals.

MR. ABERNETHY: In other words you don't know?

DR. DRAKE: At present we can't say that there are not signals nor be say there are.

MR. ABERNETHY: By the way, how far away are you observing?

DR. DRAKE: The two stars we are observing in the first attempt are about eleven light years away. This means that any signals we might originated eleven years ago.

MR. ABERNETHY: Dr. Struve, have the results so far met with your ectations?

DR. STRUVE: Yes, I am very much in favor of the observations that e been made and that will be made. I expect that after some period of e has been devoted to the present observations there will be an interrup- n. The next step will probably be of the observation with an even larger e of antenna.

As Dr. Drake has explained, the reach in space now is relatively small Dr. Drake is observing only two stars at the present time.

Now if he had a larger antenna, say a 2,000 foot antenna instead of an 85 foot antenna, we would probably reach out into space, about how , about a thousand light years or so?

DR. DRAKE: Something of that order.

MR. ABERNETHY: Dr. Drake, if signals were coming our way from intelligent creatures, what do you expect the signals would say? How would you expect to receive them?

DR. DRAKE: It is very difficult to imagine what a signal would be that we would receive from another creature. About all we could say is that there would be something systematic about it. It might be dots and dashes or what have you, but it would be systematic and that is all we can say.

MR. ABERNETHY: Assuming that we receive signals, do you think we can ever learn to communicate with those others?

DR. DRAKE: Yes, I am sure we can. After all, a child learns to communicate and we have the same advantages that he has.

MR. ABERNETHY: How will we do it?

DR. DRAKE: Well, there are several ways. We can use what might be called the cosmic Rosetta ^{Stone} which consists of the laws of physics, the laws of mathematics and the arrangement of the universe which are common to all civilizations. Probably a more efficient way is to use television and to teach the language just the way a child is taught to speak. Show him an object and give him a name for it.

MR. ABERNETHY: Television over eleven light years?

DR. DRAKE: Yes, this is quite feasible.

MR. ABERNETHY: If you could communicate with other creatures what would you want to ask them or what would you want to say to them?

DR. DRAKE: I think it is almost impossible to say now what we would want to ask such creatures. The first thing we would have to find out is what sort of creatures we were dealing with.

MR. ABERNETHY: Dr. Struve, if we ever do make contact with other creatures, will you expect to find them less advanced or more advanced than we?

DR. STRUVE: I would say more advanced, probably. I did not at any time say there are such creatures now in existence. Your question was "If contact is made." Now chances are if such a contact were made, that their civilization would be more advanced than ours because our civilization had not yet reached the point where we are sending signals to other beings in the universe.

DR. DRAKE: As Dr. Struve said, the question here is one of probability. With all the stars we have, the probability of there being other creatures is extremely high, and maybe the proper question to ask is, is there intelligent communities sufficiently close to us for us to contact and this is very difficult to say.

MR. ABERNETHY: And if you had a 2,000 foot telescope, do you think you would find signals from intelligent life?

DR. STRUVE: Well now to be absolutely truthful, I would say that I do not expect to live long enough to have those signals recorded.

MR. ABERNETHY: What about Dr. Drake?

DR. STRUVE: Well, Dr. Drake is a very young man and he may live long enough to see some.

MR. ABERNETHY: If we ever do get signals from another intelligent community, some people say we should not answer, we should not let them know of our existence because inevitably there would be a fight. What do you think of this?

DR. DRAKE: I think it is too late. Man has been radiating vast

am' its of energy off into space for at least thirty years now and anyone who is very advanced and who wants to become aware of our presence is certainly capable of doing it already. There is no use in being still at this time. It is too late, now.

MR. ABERNETHY: Dr. Struve, do you have any special name for the others who might be out there?

DR. STRUVE: This is a new question. No, I have no other name and among ourselves we call them "The little green men."

MR. BRINKLEY: If there are "Little Green Men," what might they look like? One man with some opinions is professor of Anthropology at Harvard, Dr. William Howells. Dr. Howells

DR. HOWELLS: I think the others would probably be something like us. Of course, they might be so totally different that we can't imagine them at all, but they would have had to appear by evolution like ourselves, and we know the same natural laws hold everywhere. We have gravity here, they have gravity there.

All this talk of communication is futile unless these other people can communicate, unless they are highly evolved, intelligent beings like us. We aren't going to communicate with algae or insects. What does this mean? It means a brain, that is to say a center of intelligence, and a high speed nervous system. And we can't imagine such a thing evolving without a good use for it. This means input and output, in our case it means senses like eyes and ears and also muscles and the ability to move around, above all a pair of hands with fingers. These are the things we got by evolution.

The other people must have senses to communicate with. We use our ears for receivers, but we also read with our eyes, or even by touch if we are blind.

Possible they don't speak and hear if their atmospheres aren't right for sound. The chances are excellent that they see with eyes. Their world must have light, and eyes have evolved several times over here on earth. Their minds could easily be an improvement on ours. However, we are on better ground when we ask ourselves what they will look like, because we understand our own bodies better than our brains.

Land animals use legs for moving. Legs are found not only in our own animal group, the vertebrates, but in the insects and their relatives, like spiders and crabs as well.

These same animals also have heads or head ends, where they eat and see, and perhaps smell or feel with antennae or whiskers. Cats, houseflies, even lobsters. There you have the ground plan for successful animals on the surface of this earth. A head at the front, a body with two sides, and limbs. It gives them what I required: seeing and moving, or input and output, with the brain between them to make them efficient.

This may not be the best plan in the universe, but it gets the most votes here on earth.

At any rate, it favors the idea that people in space are fundamentally like ourselves. The only improvement I can suggest is that they would be better off than we are if they had four legs to balance on and two arms as well.

Land animals on earth develop from fishes with only four limbs. So that when we evolved we had to balance on our hind legs in order to use the front ones for hands. This may strike us as a noble attitude, but it is not sound engineering.

So I will guess that the typical outerspacer will look like the mythical Centaur, half man, half horse with six limbs, four to stand on and two to use.

There's another interesting question, sex. This is not necessary to reproduce. Some kinds of life manage without it. But having two parents to

combine their different units of heredity greatly increases the variety of the offspring. And this variety is what makes evolution work efficiently, by picking and choosing. This is the real reason for sex, and so the chances are they have it elsewhere, as well as here. They might even have more than two sexes, but two is enough for the purpose.

How big they are would depend on problems of heating and on gravity. Large animals are more intelligent than small, but they run into gravity problems. We are just about right for the earth, but people from other worlds might be larger or smaller. They might turn out to make nice pets for us, in fact. Or we might make nice pets for them.

MR. BRINKLEY: Our report continues with a look at plans for the space ships of tomorrow, in just a moment. (Commercial)

One of the facts of the space age is that almost every major American aircraft and engine company has detailed plans for space ships they would like someone to buy. Roy Neal reports from Hollywood.

MR. NEAL: In 1865, a crew Captained by the famous author Jules Verne was fired from a cannon for a round trip to the moon. As far as we know they were the first humans to travel in outer space.

In 1929, Captain Buck Rogers became the first American when he took off in THIS ship for the planets.

By 1938, things had progressed. The Earth was invaded by Men from Mars. We heard it on the radio. All science fiction, of course. And there's a lot of it today. Its lots of fun.

But in the Year 1960...a real Rocket Plane, The X15, is resting at the frontiers of space. And we have real satellites, and man made probes in outer space.

We also have big corporations, working with the right hand on today's

ce programs while with the left they are making plans and blueprinting
jects they hope to sell in the future. In a highly competitive business
se corporations must plan ahead. None of these designs have been bought
, but every one is considered practical by the well paid scientists and
ineers who conceived them.

Let us begin at the level of manned space stations. The Boeing Airplane
pany figures this research station can accommodate twelve persons and
ain in permanent orbit about 300 miles above the earth. It is designed
be sent up as a single package...and is complete with a sixty inch
lescope in a trailer.

The Lockheed Company figures differently. Their proposal uses pre fab
ts that would be assembled in space. When coupled and working, a ten
crew could live in this 94 foot wheel...in fifteen compartments like
e of a ship at sea. There's a space ferry to move supplies and men to
from earth...and an astro-tug for repairs.

That same company has a second space station design on its drawing
rds that uses a building block type of construction so that it can be
arged as required. According to its designers, this station could be
operation within ten years, if approved.

Other ideas range from...Rocketdyne's five man space station...to
ir fifty man one...for the day when we have big engines capable of
ting a quarter million pounds in orbit.

A maneuverable satellite...and an inflatable one. If meteors puncture
s "Balloon with men inside" colored gasses would spot the leak for
ching...

Northrup figures that electrical power could be obtained for their
r man space station from a bank of solar cells.

Martin says we could have this space station within the next five years...using new engines now being constructed...the big dish is for power from the sun, the little extension is a nuclear power supply...there's a way for the trips to and from earth...and a space tug to complete the plan.

Another proposal which hopes to capitalize on big engines now being developed comes from the famous Kraft Ehrlicke of Convair Astronautics. Called "Outpost 2" it is intended as a training station to acclimate would-be space crews for living in space. The whole thing rotates slowly, end over end, to provide artificial gravity. An atomic power supply is separated from the living quarters to keep radiation away from the crew.

There are laboratories working on the problems of food and air supplies...on ways to make space vehicles self sustaining with a just right balance of plant and animal life such as our own world maintains.

At Boeing right now, specially bred bacteria reduce matter to liquids and the microscopic plant, algae, purifies the air supply as well as being used to make an edible white flour for food. These are edible space cookies...made from algae. (Crunch) and you can eat 'em...After three or four years on a planetary expedition diet of Algae and Bacteria...imagine the reaction when a space man gets back to his first big, juicy steak.

A number of industry spokesmen say that perhaps within ten years...from a manned space station in orbit, a manned space ship will take off...to and land on the moon. Film from North American...who make the X15 among other things shows how they think it will look.

Another big company...Douglas...has set up a moon station...with living quarters...tugs...a space port.

Boeing's Martian Explorer could be assembled in space and has a self-sustained solar power transmitter and their counter moon research station might be handy for such things as navigation of space ships.

Here's a detailed study for fast manned reconnaissance flights to Mars Venus. Nuclear power...Real food supply using algae products for agencies...Mission profiles...Only 541 days for a round trip to Venus, days round trip to Mars. Unusual design...those tanks drop off when y're used up.

And here's the interplanetary chemo-nuclear-electric spacecraft ania."

Aerojet General...who are in the engine business have this four stage el as a proposal for a lunar transport. They have also just completed easibility study of a simplified big engine ship called Cosmos... lce its size compared to the little car at the base.

Rocketdynes space ship design that would draw its power from the sun. one uses nuclear power. The wings would radiate excess heat in space... t be used for landings in an atmosphere.

Remember the sound barrier for airplanes? One scientist at Norair alizes a "Disintegration barrier"...from dust particles in space... h might limit our speeds to less than that of light and confine us to own solar system.

Of course there are many much more immediate problems to be solved.

In a laboratory at IBM...Radar systems for navigation are being t and tested.

Another new type navigation device will work from a computer to joint locations on a map...This one is for work near earth, others will the planets. All based on the need for electronic backup in naviga- guidance and communication to make up for human shortcomings.

On the outskirts of the space business, for many years the makers of for models you assemble at home have had access to the files of the companies. This is the Helios. Scientist Kraft Ehricke's design...in

a model from Revelle. Their files are marked top secret and kept locked. This Model 7 The XSL...experimental space laboratory...lll...was designed by a research scientist now with Lockheed. They have no models though for the kind of space ships you and I may ride in...perhaps as soon as 1980 if we believe some top executives in the airplane and space ship business... but there are some well considered calculations.

Douglas Aircraft builds passenger planes...has gone to the trouble of this brochure with costs, sizes and shapes for a space transport system.

They figure its possible to run tourist specials to Mars to see a sight like this every couple of years when that planet is closest to Earth and the trip will be shorter as a result...^{at}a round trip cost as low as 2000 dollars. Figured in are such important tourist necessities as stewardesses and luxury foods.

All based on a practical high thrust nuclear powered rocket engine.

Which points up the big problem of how to get more than one flight out of a rocket. Our present systems are uneconomical since the rocket is used only once and destroys itself in the process. It's like being able to take your new car for only one ride.

A top scientist at Aerojet, Robert Truax, proposes recoverable engines, parachuted back to earth.

At Lockheed they like a winged engine that could be flown back to earth.

Bell Aircraft suggests an airplane to get out of heavy atmosphere before the big rocket engines are fired up. They claim this design would make practical trips from Los Angeles to Paris in just over an hour.

A By-product of the Space Age. Fiction? Perhaps. But the big industry of today is spending money on its plans for tomorrow. And this week here in Los Angeles, members of The American Rocket Society...five thousand scientists and engineers...held a meeting at which exploration of the moon was one of the major topics for discussion.

Despite the many problems, to most of the industry our move into space as you can see is only a question of time...and money.

MR. HACKES: With all our talk of space travel, even with all the progress we have made, don't let the astronomical optimist fool you: missions on Mars are hardly just around the corner, not merely a few billion dollars away.

Cost is one of the problems, of course. Much of the money will go into licking the problem of power. Even small payloads need a big boost. This is Vanguard I. It weights $3\frac{1}{2}$ pounds. But it took 37 thousand pounds of lift power--thrust, as it's called--to put it into orbit. As the payloads got bigger, we had to have bigger launching boosters.

Much more power will be needed to boost man, or say a ton of instruments into space. For such a job, we'll need Saturn. Saturn is under construction right now at Huntsville, Alabama. It will fly a ton of instruments to the Moon, or to Mars or Venus. Or it can fly two men around the moon and back again.

But to get really far out, or to land man on the moon and get him back again, we'll have to have this monster. It's called Nova. When it's ready, Nova will ship two or three men to the surface of the moon, and have enough power left to return them. Nova will stand as high as 26 story building.

And that's just the beginning. The farther you go, the more weight you send, the bigger the boosters will have to be. It's as simple...and as expensive as that.

Besides cost, there are the medical problems--can man endure the rigors of space travel; the problems of protecting man from possibly-lethal radiation; the problem of bringing back something from a space bit--which has never been done; and the problem of space rendezvous--

ow to reach a point out there by aiming somewhere else. We may not be
e to learn the laws of physics in space, until we get there.

Above all, we must have ultra-reliable equipment, tested, retested,
nd tested again, thousands of times. Everything has to work perfectly
a a flight into space---no repairs possible along the side of the road.
e need to build large payloads to do many things over a very long time,
ith complete reliability.

Can we do it? Can we lick the problems? Well, we wouldn't have come
his far if we didn't think we could. But there's still a long long way
o go. (Commercial)

MR. BRINKLEY: Finally, what difference is it all making? How is
ne space age changing our minds? Dr. Glennan...

DR. GLENNAN: I think our whole outlook is changing. I think space
xploration is already having a profound effect on what we think of
urselves, and on what seems important to us.

I know I can not look at the moon anymore without wondering what is
eally going on there, and what really happened when Lunik the Second
it it. Later this year, we expect to have a useful spacecraft in orbit
round the moon.

I think the most intriguing part of space exploration is the
ossibility of finding other intelligent life. What happens if there
re Martians out on Mars who are well advanced? Most of us do not
but there is
elieve there is, enough evidence that something grows there so we should
ot write off the possibility of there being intelligent life on Mars.
or me, I find the one world idea taking a quite different, more important
lace in my thinking--if indeed there is rational life someplace else
n the universe. The quarrels we have around earth may suddenly seem
uite petty. I also think space exploration is making a significant

ference in what we believe about why we are here. Most of us have always thought our earth had a special place in the universe, and that we human beings had an even more special place. What happens to these ideas if we pick up signals from another world, from creatures more advanced than we are? I think we probably have to face up to the fact that we are not as unique, as we have always thought we were.

I think space research is going to give--not just the scientist, but everyone--a new sense of awe of the vastness of the universe, and of how insignificant the place of each of us is within it.

At the same time, and here is the paradox, everything we are doing is a testament to the genius of man.

Our scientists have been able to predict with reasonable accuracy the things they are now proving about space. Our engineers are designing and building engines and payloads of almost unbelievable complexity.

When properly trained, the human mind is a pretty amazing thing, no matter where it is in the universe. When the Soviet Union launched Sputnik and hit the moon and took pictures of the back of the moon, the world was impressed. Russian propagandists were able to give many people in the world the idea that because of the spectacular nature of her successes in space, Russia leads all other nations in all of science and technology.

We need to change that belief, and I think we are doing it. And everything we are learning we are giving freely to all other countries.

I think we are finding out more about space than the Soviet Union is. I think the rest of the world is beginning to realize this. I think, in the long run, we---not the Soviet Union---will be recognized as the nation which has made the truly significant contribution to the welfare of all mankind.

MR. MC GEE: Man has always had more questions than answers. He has bridged the gap with guesses. This has meant that with each new answer, some old guess has had to give way. This is a painful process because it stretches the mind.

We did not easily accept the fact, established several hundred years ago, that the sun, and not our earth, was the center of the known universe. This does not disturb us now.

Nor will the discoveries that may soon be made disturb us for long. We have, and will continue, to adapt ourselves to survive.

(Billboard)

MR. MC GEE: Next week at this time, a continuation of the N B C News Series "Journey To Understanding"---with a complete report on the meeting at the Summit.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

HOLD FOR RELEASE UNTIL DELIVERY
Expected 10:00 A.M., Tuesday, May 17, 1960

Statement of Ira H. Abbott, Director of Advanced Research Programs
National Aeronautics and Space Administration

before House Committee on Science and Astronautics

Mr. Chairman and Members of the Committee:

I am grateful for this opportunity to testify before this committee and to discuss with you the problem of the supersonic transport. We, in NASA, are deeply interested in the possibilities of the supersonic transport; we are aware of the advantages this country would derive from its development, and have, in fact, already conducted the research that indicates its technical feasibility in the near future.

As you are well aware, the NASA retains, under its enabling legislation, the duties and responsibilities of its predecessor organization, the National Advisory Committee for Aeronautics. The primary duty of the NACA was the conduct of scientific research in the field of aeronautics. In this area the NASA continues to function in the same manner as the former NACA.

We conduct scientific research to guide and support the aeronautical activities of the nation, both military and civilian. In this research, we cooperate closely with other Governmental agencies concerned with aeronautics and with the manufacturing and air transport industries. Our activities vary from fundamental through applied research to specific testing associated with the design and development

of specific aircraft. We do not design or develop aircraft, but we cooperate closely on technical matters with those who do and with those who buy and operate the aircraft, whether they be the military services or civil airlines. In fulfillment of NASA's duties in the field of aeronautics, our current research programs deal with problems of VTOL/STOL (vertical take-off and landing/steep take-off and landing) aircraft, advanced bombers and fighters for the military services, and supersonic cruise transports.

New aircraft are thus brought about in this country by a team effort including NASA as the primary research agency, the aircraft industry with their superb design staffs and manufacturing capabilities, and the customers, whether they be military or civil, with their unique knowledge of operational requirements. This system has worked well for over 40 years. It gained and maintained American preeminence in the air.

All members of this team face special problems in the supersonic transport aside from the technical ones which I shall discuss later. One of the most serious problems is that of financing the development of such an aircraft. Historically, large performance advances in transport airplanes have been based on the results of NACA research, and have been preceded by military aircraft and engine developments which have produced the needed technology. The current subsonic jet

transports provide a good example in that they were preceded by large jet bombers and tankers. These advances thus were assisted and made possible by government financed advances in technology. Even so, these recent developments have involved very large investments by the companies concerned.

The future supersonic transport will also benefit from NASA research and from the technology and experience generated by the USAF B-70 project. However, the step from the supersonic bomber to the transport is greater than has previously been the case, the development costs will be much higher, and the large carrying capacity of such airplanes may well result in a smaller production for the aircraft industry.

We, in NASA, are not experts in economics. We feel, however, that just as private industry needs governmental assistance to finance such projects as large ocean liners and nuclear power reactors, it will also need some form of direct assistance to develop the supersonic transport. I am convinced that this country should undertake the development of the supersonic transport even though this requires governmental financial assistance.

I would now like to turn to the technical situation regarding the supersonic transport. We in NASA have been interested in the supersonic transport since our research first indicated the feasibility of a

long-range supersonic cruise bomber. As you know, these research findings led to the initiation of the B-70 project by the Air Force. As our research to assist the bomber project became more specific as the design developed, we initiated generalized research to identify and solve the more difficult problems of the supersonic transport. This research has now progressed to about the same point as that which existed when the Air Force decided to start a design competition leading to the B-70. That is, the technical feasibility is established in our opinion in the sense that we can predict with confidence that a concerted and vigorous research and development program can lead to satisfactory solutions of the technical problems.

The first and most important technical problem for supersonic cruise airplanes is that of over-all flight efficiency which determines the range that a supersonic bomber can fly and the economy of a supersonic transport. My first chart shows the present state of the art as indicated by our research results. I have plotted flight efficiency against Mach number which represents the airplane speed in terms of the speed of sound. The efficiency of the present jet transports is seen to decrease rapidly as the speed of sound is approached. Until recently the efficiency of all airplanes at supersonic speeds was very low. As the chart shows, however, it is possible to maintain efficiency up to three or even four times the speed of sound approximately equal to that

of existing jet transports. These results hold the promise that actual flight operating costs could be about the same as for present jet transports.

I mentioned previously that the supersonic transport is a more difficult technical problem than the supersonic bomber. This increased difficulty stems primarily from the following requirements for the transport:

1. The fuselage volume must be larger to accommodate the passengers;
2. Each airplane should have a long operating life of many thousands of hours of flight to be economical;
3. The airplane must be compatible with the airports from which it is expected to operate, and with the traffic control system that can be brought into existence at the time the airplane goes into service;
4. The airplane must be socially acceptable in the sense that it must not cause undue noise at or in the vicinity of the airport or over the routes it will be flown;
5. Safety requirements are even more stringent than for the bomber and more difficult to realize;
6. The airplane should have substantial growth potential to avoid large later developmental costs to achieve increased

performance and to avoid the difficulties of bringing another completely new airplane into operation.

I obviously cannot discuss all these subjects here, but I would like to say a few words about some of the technical problems.

My next chart shows the structural temperatures for supersonic transport flying at an altitude of 70,000 feet. The temperature is plotted against Mach number for positions on the airplane wing 1 foot back of the leading edge and 100 feet back. You will notice that a temperature of 300° F is reached at about 2.5 times the speed of sound. This is about the practical limit for aluminum structures, though some recent information indicates this may be too high or unconservative. At 3 times the speed of sound or 2,000 miles per hour, the temperature is about 400° F. Such temperatures require materials such as stainless steel or, perhaps, titanium. These materials are at present excessively costly when fabricated in the manner required for this application. Much has been learned from the B-70 project, but much more work needs to be done to improve the structural design and fabrication methods to reduce the cost.

Many of the problems can be avoided, of course, by reducing the speed to the point where aluminum alloys can be used, about twice the speed of sound (about 1,300 miles per hour). Such a step to ease the immediate problems would introduce two problems for the future. First, such an airplane would have little or no growth potential as far as speed

is concerned. If it were found necessary to increase the speed, an entirely new development would have to be undertaken with the resulting delays and costs. Secondly, little is known about the fatigue problems with aluminum at elevated temperatures and the consequent effects on the useful life of the airplane. This problem is much less critical for military airplanes, and no existing supersonic airplane has flown at such speeds, or is likely to, for the long hours required of transport airplanes. Further research can help this situation, but in this area there is no good substitute for flight experience. This is an example of one type of decision that will have to be made in the design that will affect the growth potential, cost, useful life, and possibly the safety of the aircraft. Research information to provide a sound basis for this decision will be required, and some of the studies are already getting underway.

I would also like to mention the noise problem. As far as engine noise is concerned, the situation is not much different than for existing jet transports except that more power will be needed and there will be a corresponding tendency for more noise. One way of avoiding this increased noise would be to use turbofan engines, which are also desirable for other reasons, but this would require the development of a new engine. While it appears entirely possible that some new engine can be developed which would both reduce the take-off noise and provide improved performance and economy of operation, this item in itself will be an expensive undertaking.

A more important noise problem is that of the shock wave or pressure discontinuity which always accompanies a supersonic airplane. This wave sweeps along the ground below and behind the airplane causing a sudden noise which can be violent and which is known by the common name of sonic boom. This noise can be more than an annoyance because it is capable of breaking windows, causing plaster to fall, and other damage.

The NASA has done considerable research on this noise problem. We have established that, aside from meteorological conditions, the intensity depends on the altitude of flight, the speed, and the size of the airplane. The intensity cannot be reduced by changes of airplane configuration. Fortunately, the intensity is low when the airplane is flying at the very high altitudes required for economical cruise.

The sonic boom problem thus becomes important during the climb and let-down of the aircraft, because the speed should be subsonic to avoid this noise when the altitude is less than about 35,000 or 40,000 feet. The primary problem is in the climb because the configurations that are efficient at supersonic speeds are not efficient at subsonic speeds, and neither is the propulsion system. Consequently, the best supersonic configurations would use excessive fuel during the subsonic climb.

Such considerations will require the designer to compromise the configuration to obtain adequate subsonic performance. Ideally a change

of configuration should be used if this is practical. Some configuration changes have been in use so long we take them for granted, and include retractable landing gears and the large wing flaps used for landing and takeoff. We are presently investigating configuration changes to increase the wing span at low speeds which appear to offer promise of large performance gains at subsonic speeds including climb, landing and takeoff without introducing excessive complication and weight.

The supersonic transport poses formidable problems of piloting, navigation, and traffic control. Once it is in flight it must proceed along a precisely controlled flight path with little or no delays and with a large degree of dependence on automatic flight control and stabilization systems and rapid automatic traffic control over the entire route. A supersonic transportation system consists of not only the airplane but also the airport, navigation and traffic control system within which it flies. The entire system must be engineered together to be compatible.

It is apparent that the supersonic transport presents formidable technical problems. I have dwelt on some of these problems in order not to mislead you about the magnitude and difficulty of the task. Nevertheless, we believe that these technical problems can be solved in an acceptable manner. We at NASA are proceeding with our research,

but the time has now arrived when research by itself is not enough if progress is to be made at the rate that is technically possible. A concerted effort by the Government and industry design teams is needed to bring the problems into focus and perspective, and to enlist the talents and resources essential to such a difficult task.

In closing, I wish to thank you again for this opportunity to appear before you on this important subject and to assure you that the NASA stands willing and able to do its part to assure the continued preeminence of this country in aeronautical transports.

No. 60-196

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D. C.

Wednesday, 18 May 1960

NASA'S ROLE IN THE LIFE SCIENCES

PRESS BRIEFING

The meeting was called to order at 3:30 p.m.,
Mr. Herb Rosen, NASA, presiding.

PANEL PARTICIPANTS:

DR. CLARK T. RANDT, Director, NASA's Office of Life Science
Programs.

BRIGADIER GENERAL DON FLICKINGER, USAF, Assistant for Bio-
astronautics, Headquarters Air Research and Development
Command.

CAPTAIN CLIFFORD P. PHOEBUS, USN, Director of Astronautics
Division, Bureau of Medicine and Surgery.

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MR. ROSEN: Good afternoon once again to another NASA press briefing.

Gentlemen, the purpose of the briefing today is to give the first real public statement describing the NASA Life Science Program. We will outline the objectives, the programs, and the organization to meet the objectives and to get the programs completed. We will also give you something on the relationship that exists between the NASA Life Science Program and the Navy and Air Force programs in related areas.

On the panel, reading from my left, we have Captain Clifford P. Phoebus, U.S. Navy, Director of Astronautics Division, Bureau of Medicine and Surgery.

In the center, Dr. Clark T. Randt, Director of NASA's Office of Life Science Programs.

To his right, Brigadier General Don Flickinger, U.S. Air Force, Assistant for Bioastronautics, Headquarters Air Research and Development Command.

Dr. Randt will start the proceedings off with the outline of the objectives of the Program. Following that we will throw the floor open for questions and answers from Dr. Randt to Dr. Phoebus and then General Flickinger.

DR. RANDT: Ladies and gentlemen:

I would like to preface my remarks about the Office of Life Sciences Programs by saying that our reason for existence is to do what is best for the nation's space program in regard to the life sciences first, and secondly, to appropriately represent medicine, biology, and psychology in the national space program.

May I have the first slide, please?

(Slide.)

The background for this program, as all of you probably are aware, was determined by recommendations from Dr. Lovelace's special committee on the life sciences, which was appointed in November 1958 for special advice for the project Mercury, and by the Bioscience Advisory Committee appointed by Dr. Glennan in July 1959 and headed by Dr. Kety of the National Institute of Health.

The recommendations of these two committees led to a general consensus of opinion as to the role of the life sciences in the space program.

The first major area of concern, then, was the implementation of man's space flight exploration. The second major category is that of biological investigations in the space environment.

Under the biological investigations we have broken this down to include the effect of space environments on living organisms. This has to do with the effects of high vacuum, temperature extremes, the unusual compositions of planetary atmosphere, surfaces and subsurfaces as they affect living organisms at a cellular level down to a molecular level. And secondly the search for extraterrestrial life which we all hope will bear on the problem of the origin of life, and the evolution of life in the universe.

(Slide.)

So in setting up the office, the more specific objectives follow that general plan. Under the implementation of manned space flight and exploration we have chosen to separate this into two categories: one, biotechnology and, two, the basic medical and behavior sciences. Under the biological we have environmental effects of extraterrestrial environments, organic chemical investigations for evidence of extraterrestrial life, the search for extraterrestrial life forms, and contamination problems. Now I would like to take up these various categories in more detail.

(Slide.)

In the first major objective, the first of two major objectives, we have biotechnology. In our terms of reference this refers to men-machine integration; environmental stress tolerance -- that is, the definition of limits of tolerance and protection therefrom; a special category of protective equipment, escape devices, and radiation shielding; life support systems; public health problems, and ground crew safety.

We recognize that this area is the one in which the military services have great capability as regards personnel, facilities, equipment and programs, and it is in this area, biotechnology, that we will turn for major support to the military service laboratories.

As the space flights begin and flights turn into voyages, it occurs to us that there is a necessity for more basic medical and behavioral scientific studies. These would include cardiovascular physiology, respiratory physiology, metabolism and nutrition, neurophysiology and psychology, and radiology. The military service laboratories certainly do this type of work and have a number of very outstanding scientists in this area. However, the major potential in the basic medical and behavioral sciences, I believe, resides in the universities, more specifically in the medical schools of the United States. Inasmuch as this is a national program, we are very highly desirous of having the potential of the entire country represented, and we will look heavily also to the medical schools for assistance in this area.

My mention of this as to technology should not be interpreted as an attempt on my part to assign roles or missions. I merely mention our very sincere recognition of the efforts and accomplishment in this particular area which has been going on in the military service laboratories in aviation medicine for the last twenty years, and more recently in the space related problems of biotechnology.

(Slide.)

The second major objective, that of biological investigations, more specifically the environmental effects of space and planetary environments on living organisms, includes studies of the radiation effects, ionizing radiation at a cellular and down to a molecular or atomic level. The effects of weightlessness and the effect of physical changes which affect cellular processes will be concerned in this area under this category.

I have mentioned the high vacuum temperature extremes, electromagnetic fields and effects of these on living organisms, cells and tissues, and the effects of these unusual distributions of elements in extraterrestrial planetary atmospheres and surfaces. We are interested in the effects of these environmental factors on living cells and tissues.

Secondly, organic chemical investigations for evidence of extraterrestrial levels. This activity has already been started by Dr. Calvin at the University of California, and his analysis of meteorites for long-chain organic compounds. He has already been successful in determining, through organic chemical analyses, the presence of

carbonaceous chondrites in certain meteoritic samples. Secondly, the spectroscopic analysis of the Earth and other planets for organic compounds. In the range from 3 to 7 microns, in the infra-red spectroscopic analysis, one can identify organic substances and, as you know, these have tentatively been identified on Mars. Aldehydes and cellulose, or things resubbling organic compounds of that nature have been tentatively identified in the atmosphere or surface of planet Mars. We would like to promote further such observations.

One of the ways of developing this type of analysis in the infra-red spectrum is to direct our attention back to Earth and validate or qualify our observations in the infra-red spectrum by those that we can verify here on Earth.

The automatic analysis by instruments of remote planetary surface and subsurface organic compounds would include automatic analysis of these organic compounds on the moon. We would like to be on the development of instruments for that purpose, looking forward to such time as this may be possible.

Thirdly, the search for extraterrestrial life forms. One of the ways in which this problem may be approached is the sampling of the microbial content of the upper atmosphere and near space for evidence of bacterial spores or any other living organisms, and ultimately identification or attempted identification of these life forms through automatic instruments on remote extraterrestrial bodies, the moon and the planets. Obviously, particularly the planet Mars and the planet Venus.

We would like to develop methods for collection of these samples for identification of life forms for such time as it may be possible to return samples to Earth. Such collection of samples and the automatic instruments that by telemetry would record data then will bear on the major problem of the origin of life and the genetic mechanisms of evolution.

Fourthly, we are concerned in this category of biological investigations, with contamination problems, and these fall in general into two classes, those of pollution and infection. Pollution is more likely to occur on the moon where the introduction of organic compounds might confuse our observations as to whether they were residing there prior to our entry into the area of the moon, or whether they have been introduced from the Earth's surface.

Problems of infection are more likely to occur in regard to the exploration of Mars where it is possible that life-sustaining chemicals such as oxygen and water are available.

So we are interested then in extraterrestrial contamination, both in the pollution and infection field, and at a somewhat later date we will be concerned with the problems of contamination of returning samples from extraterrestrial bodies.

(Slide)

As we start this program it is necessary to have overall guidelines. These four topics outline our first thoughts on the programs that we will promote in 1961 and thereafter.

The first one has to do with planning and participation in future manned space flight missions. The Project Mercury is well down the road. The planning phase is over. It is an operational project at the present time and no change or alteration in the development of this project is anticipated. We stand ready to provide such assistance as we can, which will be largely dependent upon the personnel whom we are able to attract to our office. We will, however, be particularly concerned with planning and participation in the follow-ons to the Project Mercury in the manned space flight area.

Secondly, we intend to initiate a planned program for biological experiments in the upper atmosphere and space environment. Within the next two months we hope to have a meeting with national participation of those scientists who are qualified and interested in using the space environment as a new dimension for observation of biologic phenomena to further outline the objectives of such a program, to determine what areas should be most productive in such investigations, and tentatively to assign priorities to those areas inasmuch as these experiments are so expensive in consuming of time and effort. We believe we must have a clear-cut objective and priorities before final planning of more detailed specific experiments.

We intend to start a Grants and Contracts Program in support of the major objectives of our office in manned space flight and biological investigations.

Fourth, we intend to plan a Life Science Research Center for presentation to Congress next spring. The objectives of the Research Center will be obviously those of our office. The major outstanding justification for such a Life Science Research Center to us is that this would enable us to attract and productively utilize the talents of a few high quality individuals to provide leadership for a national program in the space related life sciences. We do not believe that we can attract the quality of individual we desire without having a place for

them to work. And we cannot have an office full of administrators and provide the type of leadership we believe is necessary.

So this is the justification for a Life Sciences Research Center. In that Center we would like to have represented three parts of our program: flight medicine and biology, space medical and behavioral sciences, and space biology. We have no intention of building this Research Center across the waterfront in order to do any major portion of our research and development work there, but we have it in order to attract and productively utilize the talents of these people we hope to get.

(Slide)

I would like to say a few words further about this Life Sciences Research Center. Under flight medicine and biology, this is the applied part of the program and would include planning and programming of specific flight experiments, as well as the design, assembly, and testing of space craft for biologic purposes. You will note that we do not include herein our applied part of the program biotechnology. This lack of planning in our Research Center reflects our desire to utilize the personnel, facilities, equipment, and programs now present in the military service laboratories.

We would like representation in the basic space medical and behavioral sciences in the categories listed here which I have gone over in detail before, and also a small number of outstanding representatives in space biology. We tentatively expect that such a facility might be on the order of 90,000 square feet and ultimately employ in the neighborhood of 60 professionals.

As we are planning and acquiring the funds for such a center, we would like to start up nests of activity in the universities and military service labs where it is desirable, and, where it is desirable, with industry, so that we will have on-going programs to feed into this Center at such time as it may be constructed.

(Slide)

The Office of Life Sciences Programs is now constituted in this fashion. There are four major categories represented, with an Assistant Director for each.

The Assistant Director for the Life Sciences Grants and Contracts Program is Dr. Freeman H. Quimby. Dr. Quimby spent eight years as Chief Scientist with the Office of Naval Research in San Francisco. During the past year he has been the head of the Life Sciences of the Army Research and Development Command here in Washington. He is our Assistant Director for the Grants and Contracts Program. I might say that we anticipate in the foreseeable future that at least three-quarters of our budgeted funds will be applied to sponsored research, grants and contracts research.

The second category is that of Bio-Engineering. Our Assistant Director for Bio-Engineering will join us next Monday, Mr. Alfred M. Mayo, of Douglas Aircraft Company, and also El Segundo, California. Mr. Mayo has an outstanding reputation in the human factors area and has been with Douglas for the past 20 years and is generally recognized as a top-flight expert in this field, both in industry and military, and otherwise.

Our Assistant Director for Bioscience will be Dr. Cornelius A. Tobias, Professor of Medical Physics in the University of California, Berkeley, who will join us on a leave of absence from the University on September 1, to fill this particular position.

We have not yet been able to secure the services of an Assistant Director for Life Sciences Research Center. We would anticipate that this man would be primarily responsible for the planning, justification, and presentation regarding the Research Center, for starting the nests of activity that I mentioned that we would ultimately like to bring into our Research Center.

(Slide)

Inasmuch as we have no capability in the Life Sciences worthy of note within NASA at the present time -- as you know, this is an organization of some 18,000 physical scientists and engineers -- we are particularly

desirous of having close support by advisory committees. These will have a more closely supporting role than the general NASA advisory committees because of our lack of capability in this area, and we have decided upon three committees. One will be in flight medicine and biology. Here the biotechnology will be included, as well as the experiments in the space environment. Included here, but not in our request for construction of a Life Sciences Center.

Secondly, the space medical and behavioral sciences.

And third, space biology. We anticipate that these will be 8- to 10-man committees and that they will closely support our operation.

Dr. Randolph Lovelace has accepted the Chairmanship of the Flight Medicine and Biology Committee, which will be the committee with which he has already a special committee for Life Sciences on Project Mercury, which will be somewhat expanded and serve both purposes, that is, advise Project Mercury and our office as well in this area.

Dr. Melvin Calvin, Professor of Chemistry at the University of California, in Berkeley, has accepted the Chairmanship of the Space Biology Committee. We have not yet appointed a chairman for the Space Medical and Behavioral Sciences.

(Slide)

We are very much aware of our responsibilities and the desirability of establishing close cooperation with other agencies of the Federal Government, and particularly with the Department of Defense.

On March 1, as this office was established, we were invited by Dr. Herbert York to describe the start of our program to individuals in his office under Dr. Reynolds, Director of Science, and we subsequently had another meeting with this group which included representatives of the Army, Navy, and Air Force, and also the representatives of the coordinating committees of the Department of Defense in Medicine, biology and psychology. We hope to establish liaison at the level of the

Department of Defense rather than dealing with the services separately, and hope that this will work out satisfactorily. If it doesn't, obviously we will have to make some changes. But our intent is to deal with this area at the level of the Department of Defense.

I would like to take this opportunity to say that my contacts and the contacts of those in NASA who are interested in the Life Sciences area have met with great cooperation and helpfulness from members of the Department of Defense and the specific representatives of the Army, Navy and Air Force, two of whom I am very happy are here with us today.

We have established informal liaison with the National Science Foundation, Division of Biology and Medicine; with the United States Public Health Service, the Assistant Surgeon General, and Dr. James Shannon at NIH; the Atomic Energy Commission, Dr. Charles Dunham and Dr. Charles Schilling; and the Federal Aviation Agency, through Dr. James Goddard and Dr. John E. Smith. We are developing our liaison with these various agencies at the present time.

I think that that concludes my remarks.

I will turn the floor back to Herb Rosen.

MR. ROSEN: We will entertain some questions from the floor to any of the speakers that you may wish to direct them to.

QUESTION: I wonder if we can get an idea of how much this Center will cost?

MR. RANDT: We have no present estimates on that.

QUESTION: Anything about where the site will be?

MR. RANDT: No, we have no information on that, either.

QUESTION: On this Life Sciences Research Center, aren't you duplicating a lot of existing facilities that the Air Force has down at Brooks Air Force Base?

MR. RANDT: I tried to make that crystal clear in my presentation, that I don't believe that that is so. I think that the major activities at the School of Aviation and Medicine are in the area of biotechnology, although there are, as you know and I know, some other activities as well. As I say, in addition to that, our justification for this Center is to attract a small hard core of high quality people for our program.

QUESTION: I would like to continue that. Why couldn't you locate this small hard core at the School of Aviation and Medicine and make use of the facilities that they have already built down there at considerable expense.

MR. RANDT: I certainly think that that is a possibility. I think the difficulties that arise in regard to that, however, are the fact that if this is for the NASA program it should be within the areas occupied by NASA at the present time. It would be more logical to do so.

I think in addition to that that there might be some difficulty in recruiting top quality scientific personnel in this situation.

MR. ROSEN: Is there a matter, perhaps, of sharing facilities and not being able to get these at the time they are needed?

MR. RANDT: I don't think that would be a problem. The matter of being adjacent to NASA, if it is for NASA, and the possible difficulties in recruiting personnel in such a situation are the main reasons.

QUESTION: Dr. Randt mentioned the follow-ons to Mercury. I wonder if we could have a rough outline of some of the ideas you people have.

MR. ROSEN: Do you mean from a medical standpoint?

QUESTION: Yes. From any standpoint.

MR. ROSEN: This is a medical meeting on Project Mercury.

MR. RANDT: As you know, these plans are just now in process of formulation. Because of their formula stage I would rather not comment on that at this point.

QUESTION: Do you have a plan to hold a meeting? I recall that about two years ago there was a meeting on biosatellites at the Willard Hotel. Do you feel anything like that would be recommended, or have you already held such a meeting?

MR. RANDT: No. We anticipate doing so and hope that this will occur late in June or early July.

MR. ROSEN: Of this year?

MR. RANDT: This year. We would like to hold it here in Washington. We would like to have national representation at this meeting to help us determine the objectives, the areas, and discuss the priorities for work in the various areas.

QUESTION: What have the Russians put up?

MR. RANDT: I beg your pardon?

QUESTION: What is your appraisal of what the Russians have done?

MR. ROSEN: If you will excuse me, this is till with relation to the NASA Life Sciences Program.

QUESTION: That is a part of it, what the competition is doing.

MR. ROSEN: Yes, as soon as the competition, if you will allow me to use the work, will tell us what they are doing. I think it would be unwise to speculate until existing information is made available to everybody.

QUESTION: Why can't you qualify it and say on the basis of existing information this is what it looks like?

MR. ROSEN: All right. On the basis of existing information, would you care to comment on what you think the Russians have? In which case? They say there is a dummy in their satellite now.

DR. RANDT: I think General Flickinger is better qualified to answer that question than I.

GENERAL FLICKINGER: I think I am just more foolhardy.

On the way in I was asked if I had any ideas. Sure, I always have them, and I stated them the evening after it was announced. Very briefly, as you recall along about 1955 through 1959, the Russians augmented considerably their animal and space probe experiments. To summarize very rapidly the conclusions that they drew, that I think is pertinent to the question asked, I would simply state that they felt that the effects of the rocket flight, the dynamic forces involved, the effects of the period of weightlessness and everything else, had no irreversible effects upon the subjected animals.

However, they made considerable point of the fact in all of their summaries that the actual mechanics of the recovery phase was the most difficult part of the experiment and they lost subjects and records as a result of failure of the components in that phase.

Last year when Dr. Lovelace and I were in Russia there were two medical aspects of the total area of man in space on which they were most interested in exchanging information. The first again was how far we had gotten along in handling these dynamic forces of re-entry -- stabilization, heat pulse, and the deceleration and impact forces. This was general item No. 1.

No. 2 was how far had we gotten along in consideration of the monitoring on a biologic scale, you might say, of continuous monitoring of space ambient radiations.

In the July 1959 shots they used a total capsule weight of approximately 5,000 pounds and contained in this capsule was quite a large variety of experimental test animals.

It also became apparent from some of the results that they may have done two things in these particular experiments to

really wring out their re-entry sequencing by having the total package come back in at escape velocities, by virtue of the computed height and the computed angle of re-entry. This you might say would be proof-testing a manned capsule to the extreme limits in malpositioning prior to angle of re-entry.

It is possible that in this experiment they did make some attempt at monitoring ambient radiations and perhaps some attempt to carry out preliminary investigations on some shielding problems.

This last satellite shot I think again in my own terms fits the general pattern of events and really brings them up to a point in time where you might say they are ready for a manned shot, and I think probably maybe more than a single man in orbit.

What I think that they have done -- of course, we have known from extrapolations of their Luniks and other shots that they had a capability of putting up somewhere in the 300-mile circular orbit range, somewhere around 10,000 pounds. Ten thousand pounds, as you all know, is something that you can do a great amount with. You can do things like adding another crew member. You can do things like adding accessory lift devices, and all sorts of redundancy in terms of the mechanical reliability and safety of the total configuration.

What I believe that they did on this particular shot was to put up their total orbiting payload of around 9,000 pounds.

QUESTION: Nearly ten.

GENERAL FLICKINGER: Yes, they have stated that this total body is going to do part of the re-entry, and at a certain point in time there is going to be an injection of a hermetically sealed crew cabin of approximately 5,000 pounds. Now, why do they want to carry out this particular separation? I think they wanted to do it for these reasons: First of all, if you have studied any of the heat pulses from either our old Air Force capsules, manned space capsules or Mercury, you will realize that your heat pulse in a ballistic re-entry, although it is a short and fairly steep peak, nevertheless maintains a fairly high temperature in the capsule over a relatively long period of time even after it gets down on the ground.

In other words, even at the end of an hour or two you still have a fairly high ambient temperature inside of

your capsule.

I think that what they are planning on in this particular configuration is really an emergency that would handle, first of all, a considerable deviation from the projected flight path of the main body. In other words, if it begins to develop tumbling moments or oscillations that become intolerable.

Secondly, if this comes down, we will say, and if the majority of the transfer of the velocity goes into heat, and the bulk of your heat is contained in the outer shell, then we will say at somewhere between 60,000 and 40,000 this thing would be ejected with the crew and stabilized and drogue down much as our Mercury capsule and you would be completely relieved of the remaining heat that is contained in the outer shell.

So that your chances of survival, once down in the terrestrial situation, in case you had injury, would be much greater.

Lastly, and this probably is not too important, but again I think it refers back to a concern of theirs because they have so much extra thrust to play with anyway, lastly would be the question of getting some misalignment of their thrust and stabilization and put themselves into an eccentric orbit, the apogee of which will be in the proximal Van Allen layer, in which event they would get a considerable ionization, bremsstrahlung and activation of the outer shell, they could initiate re-entry and considerably reduce the exposure of the individual in the inner shell by pulling him out of it just as soon as it had accepted the bulk of the stress of re-entry.

QUESTION: What are the shots you referred to of last July? I don't recall.

GENERAL FLICKINGER: They did, I think on July 2 and July 7 --

MR. ROSEN: These were straight up and down.

GENERAL FLICKINGER: Straight up and down. They did two separate series in which they had quite a menagerie aboard.

QUESTION: General Flickinger, in our Discovery capsule we tried to get it back 26 or 27 hours after launch. The Mercury will be scheduled for only three orbits.

MR. ROSEN: Could I interrupt? There is no relationship between the recovery phase of the Discoverer program and the Mercury program.

QUESTION: I am quite aware of that. It seems to me that the Russians may be trying to do the two things together here. But the point is that in both of our programs we tried to do it fairly soon after. It is a one-day operation. Here they have been up several days. Do you think that their capsule may have failed? Do you think they are programming it for a week in space before they bring it down or what?

GENERAL FLICKINGER: I think it is an open-ended experiment. I think that really there are two parts to this thing that I have just mentioned, my own opinion of what they could possibly gain from a particular configuration like this. The other thing, which is probably equally important, is the determination of reliability of components by time. This is the big bugaboo in any life spore system, as you well know.

So my feeling is that they will keep the thing up as long as everything is functioning, you might say to test it to extinction almost.

MR. ROSEN: Gentlemen, we are going far afield of life sciences.

QUESTION: Why not some kind of animal, General? Is it that the weight factor of the life sciences system would be too much penalty to pay? Why don't they have something that is alive in there?

MR. ROSEN: Shall we make this the last one on this?

GENERAL FLICKINGER: Again, I think this goes back to a peculiar philosophy that the Russians have established, and they have certainly exhibited to us over there: I think they are sensitive on the point that many people over the past generation have impugned the Soviets with thrusting out life very cheaply. I think they realize that they have a tremendous propaganda device here if they go over completely on the humanistic side. And I think they learned their lesson from Laika and that they haven't put an animal up here because

they want to say that we have actually subjected no living creature to a total space experiment until we know that we have proven out all of the aspects which will bring the animal or man back in a safe return.

MR. ROSEN: Do we have any questions on the NASA life science program?

QUESTION: In the Kenney report there is a statement that the military services presently appear to possess a capability in excess of their own needs -- this is with respect to life sciences -- and are eager to cooperate in every way possible.

It doesn't seem -- unless the military does go into space work, which they don't seem to be able to do politically at this time -- that the military will be using their life sciences laboratories very much. That is, they still will have excess time. Does this mean that NASA will be employing the military as a life sciences aid from here on out?

DR. RANDT: We intend to have it that way and we would like the support by direct transfer of funds.

We want to support the desired projects in the military service laboratories by direct transfer of funds.

QUESTION: Then in effect NASA will be employing the military, the military's laboratories?

DR. RANDT: Correct.

QUESTION: What will these machines be like that will identify organic compounds? This will be landed on the surface, it will dig a hole and filter through substances?

MR. ROSEN: The question is on the technology that will be used.

DR. RANDT: This is just at the beginning of it. But the suggestion has been made that to land a mass spectrometer or a heat emission spectrometer that will identify organic compounds, and at first telemeter this data back. Dr. Lederberg, the Nobel Prize winner in genetics, is now developing a device for identifying life forms with an automatic microscope with a fixed focal length of quartz rod light source in a vidicom tube for the purpose of remote analysis of life forms.

QUESTION: It seems like it is a rather peculiar relationship, then, with the military working for a civilian agency on a long-term basis. I wonder how this affects the military.

MR. ROSEN: You recognize that NASA still transfers funds to the Air Force and Army for some of its projects that are not associated with life sciences.

QUESTION: This looks like a long-time relationship. The military have been working for a civilian agency.

MR. ROSEN: When you say the military you are talking about a great big ball of wax. We are talking about small elements. Where talent is available and we are able to purchase this, I think we will do it rather than duplicate the facility or duplicate the talent. We will try to seek it out.

CAPTAIN PHOEBUS: We in the military, in the Navy, have been for a long time going as far out in probing advanced space aeromedical problems as we can. I might mention two examples which are I think illustrative. One is the work we have done with our centrifuge at Johnsville. This is an advanced instrument for probing all facets of acceleration that is not equalled any place else in the world.

We have a limited amount of funds in order to pursue these interests which are of interest to us from a military viewpoint, and we intend to continue pursuing these interests, whether they are for aviation or space vehicles. We still need the same kind of fundamental knowledge.

Here in this relationship with NASA we have a chance to accelerate this whole thing in our mutual interest. The problems are very much the same. The fundamental knowledge that we need in order to solve them we are going to get eventually. This is a means of accelerating it.

Another example perhaps is our study of disorientation at Pensacola. Here we have developed some devices, a human disorientation device in a rotating room, that was planned over a period of years long before anybody started thinking about space. Now, with this space problem confronting us, they come into a new ballpark of importance and we will be able, with NASA's help and hope, to accelerate our investigations in this area which are important to us

whether we are going to go on in advanced aircraft or in a space vehicle. It is a mutually profitable working relationship.

MR. ROSEN: I think that answers it.

QUESTION: Another question on how the NASA space flight program is developing. I wonder if one of the gentlemen could give us an up-to-date report on the status of the Redstone flights, either manned, unmanned, monkeyed, or what have you?

MR. ROSEN: I think that is a bit afield at this time.

QUESTION: Why?

If they don't know, they ought to.

MR. ROSEN: Status is as scheduled is the best I can give you at this time, unless somebody wants to add to it.

Are there any more?

If not, thank you very much.

(Whereupon, at 4:23 p.m., the conference was concluded.)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

FOR RELEASE UPON PRESENTATION:

Expected around Noon, Wednesday, May 18, 1960

Address by Ira H. Abbott
Director, Office of Advanced Research Programs
of the
National Aeronautics and Space Administration
before the
American Association of Airport Executives
New York City

May 18, 1960

Ladies and Gentlemen:

I want to thank the members of this distinguished organization for the opportunity to discuss NASA's aeronautical research program, with particular reference to the supersonic jet transport and its possible effect upon airport design, facilities and management.

I think you will all agree that in our business, it is equally ~~a~~ interesting to look back as it is to look forward. A mere 20 years ago, for example, some of us at the National Advisory Committee for Aeronautics -- NASA's predecessor organization, which we absorbed -- were acquiring research information to develop a practical 400 mph military airplane. Today we are deeply involved with research on a 2,000 mph commercial jet transport capable of whisking passengers from New York to London in less than two hours. With three transatlantic flights a day, such an airplane could carry nearly as many passengers in a week as

the Queen Mary which takes almost a week to cross. It wouldn't take many of these airplanes to handle all trans~~ocean~~^{ocean} passenger traffic. Supersonic air transportation will bring such trips into the commuting range.

I am optimistic about supersonic transports despite the myriad of difficult problems we have yet to solve. I think we can have operational supersonic jet transports in about 10 years. Apart from the airplane itself, and its economics and efficiency, supersonic air transportation will involve changes in the entire complex of airports, traffic control, and navigational and safety systems.

Once a supersonic airplane is airborne, it must fly along a precisely controlled flight path with little or no delay. It must rely heavily upon automatic flight control and stabilization systems, and rapid automatic traffic control and weather forecasting over the entire route. These airplanes will be moving much too fast to depend solely upon very much "eyeball" calculation. In short, a supersonic airplane requires a finely engineered, compatible transportation system.

Tied in with the supersonic transportation system will be a network of feeder lines. Depending upon the circumstances and geography, these lines will employ vertical take-off and landing (VTOL) aircraft, short take-off and landing (STOL) aircraft, helicopters, and/or medium-range jets and turboprops.

Take-off runway requirements for supersonic transports are difficult to pin down at this juncture. They will depend largely upon power plant arrangement and aerodynamic design. One such arrangement under study proposes to employ four turbofan engines which could get a 100-passenger plane off in less than 10,000 feet. Other studies, depending on the number of engines and the thrust to weight ratio used, indicate that perhaps a 12,000 ft. runway may be required. But here I would like to add a note of caution: as you know, history has shown that we have had a tendency to underestimate these things.

It is likely that these 350,000- to 600,000-pound airplanes will require considerable reinforcement and smoothing out of runways and taxi strips. The response of supersonic transports to accelerations due to the roughness of runways and taxiways is a subject for further study. In the next 10 years, more people than ever before will be flying in larger, faster airplanes over greater distances than ever before. This adds up to problems for the airport executive.

As for development of the aircraft itself, it involves equally many prickly problems, the first of which is expense. I believe that the supersonic transport will be borne of teamwork between the FAA, NASA, perhaps the military and the aircraft industry, with their superb design staffs and manufacturing capabilities and their operating customers -- the airlines -- with their unique knowledge of operational requirements. This system has worked well for more than 40 years, gaining U. S. supremacy in the air.

Now, to the technical problems.

Flight efficiency of most proposed supersonic transport designs is high at their design cruise speed but low at subsonic speeds. On a trans-ocean flight, for example, a supersonic transport may use up as much as one-third of its fuel during climbout, if subsonic climb is used for noise purposes. The reason for this, to over-simplify, is that at supersonic speeds, very little wing surface is required whereas more wing surface is needed in the subsonic range.

Next, we have the problem of drag. Using poetic license, I would say that the drag encountered at supersonic speeds will be three times that of the subsonic transport. Adequacy of current aluminum structure for cruising near Mach 2 at around 200 degrees Fahrenheit has not been established definitely. The outer skin temperature at Mach 3 will be about 400 degrees Fahrenheit -- hot enough to bake biscuits. Therefore, today's conventional construction methods must be extended into areas of new knowledge and new techniques of fabrication. The use of stainless steel and sandwich-type construction may be required, but much research has yet to be done.

Then there is the safety factor. Today's jets fly at about 40,000 feet. Supersonic aircraft will cruise at 60,000 to 70,000 feet and must incorporate features to eliminate the danger of decompression.

Finally, we have the problem of making the supersonic transport "socially acceptable" from the noise standpoint. As far as engine noise

is concerned, I believe it can be held close to the levels we have today with existing subsonic transports. If turbofan-type engines are developed to their fullest potential, the total noise power may be somewhat reduced and the noise spectrum will be shifted to lower frequencies. Jet exhaust mufflers may be eliminated, but some provision to reduce the fan noise both on the ground and in flight will be incorporated. Ground run-up jet exhaust mufflers will still be required.

Another noise problem is that of the shock wave or pressure discontinuity which always accompanies a supersonic airplane. This wave sweeps along the ground below and behind the airplane, causing a sudden noise like a crack of artillery fire. It is commonly called "sonic boom" and I needn't elaborate on it for you gentlemen. As you well know, the sonic boom can be more than an annoyance because it is capable of breaking windows, causing plaster to fall, and other damage. However, it is fortunate that the boom intensity is low when the aircraft is flying at the high altitudes required for economical cruise.

The sonic boom problem is most important during the climb and let-down of the aircraft, because the speed should be subsonic to avoid this noise when the altitude is less than about 35,000 or 40,000 feet. The primary problem is in the climb because the configurations that are efficient at supersonic speeds are not efficient at subsonic speeds, and neither is the propulsion system. Consequently, the best supersonic configurations would use excessive fuel during the subsonic climb, as I said earlier.

NASA has done considerable research on this noise problem.

It would be nice to say that we see our way completely out of it, but we do not. However, we have established that, aside from meteorological conditions, the intensity depends on the altitude of flight, the size of the airplane, and to a lesser extent on the speed of the aircraft.

Considerations of the climb-out noise problem will require the designer to compromise the configuration to obtain adequate subsonic performance. Ideally a change of configuration should be used if this is practical. Some configuration changes have been in use so long we take them for granted; they include retractable landing gears and the large wing flaps used for landing and take-off. We are now investigating configuration changes which indicate promise of large performance gains at subsonic speeds including climb, landing and take-off without introducing excessive complication and weight.

We at NASA have been interested in the supersonic transport since our research first indicated the feasibility of a long-range supersonic cruise bomber. As you know, these research findings led to initiation of the B-70 bomber -- aptly named the "Valkyrie" for the mythical Norse war maidens who hovered over the battle choosing those who were to be slain.

In some respects, construction of the supersonic transport will be more difficult than building the B-70. For example, the commercial plane will need more space for passengers, luggage, and so forth. We achieve

efficiency at supersonic speeds by means of slender shapes, and the supersonic bomber can have a much narrower waistline than the transport. Furthermore, each airplane must have a long operating life to be economical. It must also have substantial growth potential to avoid large later developmental costs to achieve increased performance. This question of choosing the right size initially is a critical one.

I have merely touched upon the major problems we are facing with the supersonic jet transport. But there is no question of either its feasibility or its inevitability, both as a national prestige symbol and a commercial must.

In conclusion, I would like to say a few words about NASA.

Of late, many persons have expressed the fear that with NASA's pre-occupation with its space mission, aeronautics will be neglected. I assure you that this is not the case.

We are frequently asked to say how much of our research is being directed toward aeronautics, how much toward space flight. It is well-nigh impossible to say. We are not dealing with oil and water -- aeronautics and astronautics blend. Basic research in heat-resistant metals, for example, may lead to applications in both areas. Space vehicles must fly into and out of the atmosphere. At NASA we are at work on everything from the zero-speed VTOL aircraft to boost-glide vehicles capable of satellite speeds. As long as there is a requirement for new concepts in air transportation, we at the NASA will be at work on the research problems. To say the least, technical progress indicates that air transportation has a bright future.

No. 60-198

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

For Release on Delivery
May 19, 1960
Expected at 10:00 a.m.

Statement by
T. Keith Glennan, Administrator
National Aeronautics and Space Administration
before the
Subcommittee on Independent Offices
of the
Senate Committee on Appropriations
May 19, 1960

Mr. Chairman and Members of the Committee:

I want to thank you for this opportunity to testify in behalf of NASA's 1961 fiscal year budget appropriations request. As passed by the House of Representatives recently, H.R. 11776, the Independent Offices Appropriation Bill, contained a \$38,985,000 reduction from the \$915,000,000 recommended by the President for the National Aeronautics and Space Administration.

We are here today requesting a complete restoration of the funds eliminated. I would not be carrying out my responsibility to the Congress, as well as the Executive branch of the Government, if I did not inform you that this reduction will materially restrict, if not substantially jeopardize, our progress toward the national objectives of scientific and technical leadership in the aeronautical and space fields.

I must bluntly inform you, without indulging in either hysteria or unsubstantiated cries of alarm, that the cut made by the House is in no way compatible with NASA's responsibilities for the initiation of long lead time projects or the acceleration of national priority programs such as manned space flight and the Saturn program. Nor is a reduction of any amount in NASA's urgently needed funds, consistent with criticism from some Congressional quarters that our budget and program have been and are inadequate. It is impossible to correlate some times well founded criticism of deficiencies in the U.S. space exploration program with Congressional reductions in vital areas of that program. On the one hand we are repeatedly urged to "leapfrog the Russians" with our technological efforts and on the other, we are expected, apparently, to carry out our space efforts with reductions of a budget that is, in many ways, already too conservative.

Although the NASA has been in operation for only eighteen months, for the second consecutive year NASA has already had to come back to the Congress to request reinstatement of cuts in our original budget requests. Today, and for the foreseeable future, our most precious ingredients are time and capable, imaginative men. The time advantage enjoyed by our

international competitor will not be reduced when we adopt the philosophy advocated by some that funds requested from the Congress can be obtained, if still necessary, after a year's delay.

The space exploration program of the Nation has gained considerable momentum in recent months. All of us, I am sure, are gratified and reassured by the successes of Vanguard III, Explorers VI and VII, Pioneer V, and Tiros I, the experimental weather satellite. Pioneer V, in carrying communications further from the earth than has ever been accomplished before - 10,201,113 miles as of noon today--is a breathtaking pioneer in space exploration. Similarly, Tiros I, with its amazingly successful photographic coverage of cloud formations over millions of miles of the globe, has provided the American public and the rest of the world, the first tangible indication of the practical benefits that will flow from space research in the near future. Beyond even these spectacular achievements, the ratio of successes to failures in all of our space flights has improved somewhat in recent months. The detailed score board will be shown to you later in our presentation.

In the past year, NASA has prepared and placed before the Congress and the people the Nation's long-range plan

for space exploration. The ten-year objectives of this plan have met with an encouraging and stimulating public response. Although we still are confronted with disappointments, such as in Project Echo recently, and although problems of major magnitude lie ahead, our scientists and engineers face the future with confidence and conviction. They are entitled to the Nation's firm and unwavering support.

As the Committee members know, the United States trails the Soviet Union in one area of space technology--that of high thrust launch vehicles. While we expect during calendar year 1961 to be able to fly a few missions using the new Thor and Atlas Agena B and the Centaur launch vehicle systems, the Saturn vehicle with 1.5 million pounds of thrust will not become operational until 1964. It is our belief that only then can we be fully competitive across the board with the Soviet Union in space exploration. In view of the long lead times required for developments such as these, the issue as to whether this is the time to reduce a "hard core" space exploration budget must be squarely faced.

Here are some basic facts which will be discussed in greater detail for you by our Associate Administrator.

The \$38,985,000 cut of the House, when related to the \$915,000,000 requested by NASA comes to four per cent. But a major part of the \$915,000,000 is committed for incrementally funded, prior year contracts, or for the continued prosecution of programs requiring sustained effort for several years. Since it would, in most cases, be expensive--and in all cases wasteful--to cancel or restrict existing projects, we can only apply this cut sensibly to uncommitted funds if we are to avoid a substantial unbalancing of our research activities. Accordingly, a four per cent reduction must be taken on a much smaller amount of funds and the percentage radically increases--in some cases, up to 20 per cent. What I am saying is that the proposed cut must be viewed as a rather substantial percentage of the programmed expenditures which will be affected.

Secondly, research and development costs have risen since preparation of the fiscal year 1961 budget request to an extent that we have become increasingly concerned about our ability to meet planned program objectives within the limitation of the total \$915,000,000 requested.

We are not happy about this situation but candor compels me to point out that it is not to be unexpected.

Costs outrun estimates in research and development operations for many reasons, the most important being that, by definition, research takes us into the unknown where precise estimates are difficult--in fact, impossible to achieve in many areas. Programs are changed to meet new developments, unforeseen difficulties occur, acceleration of activities takes place to meet new schedules, cost increases are confronted--these are the day to day realities of the research and development business.

Nevertheless, NASA budgets tightly because we believe it the most sound method of fiscal operation and because we believe the Congress would not want us to do otherwise. But, we still face the fact--and I have been candid with Congress about it--that we are in the Kitty Hawk stage of an exceedingly costly, rapidly developing technology. In top priority projects such as Mercury, we are, in effect, designing on the lathe. What this adds up to is that at this stage in the development of the Nation's program, our activities are apt to get ahead of estimates.

In the report of the House Committee on Appropriations, the recommended reductions were made on a program-by-program basis and they seem to imply that we had provided a margin

of approximately three per cent as a contingency in all the program estimates. As I suggested to you earlier, the NASA operating experience over the last eighteen months has consistently demonstrated that the estimates presented to the Congress have been lower than eventual costs. And yet we believe that sound budgeting requires that we make every effort to be conservative in our cost estimating. In providing the Congress with honest fiscal estimates, I can assure you that the NASA has no cushion to absorb either cost increases which already face us or reductions in the funds as voted by the House.

In fiscal year 1960 for instance, there have been major overruns on Tiros I and its booster, on the development of the Nuclear Emulsion Recovery Capsule (NERV), and on the Pioneer V and the Explorer satellites. These unforeseen cost increases have had to be covered at the expense of other programs since no contingency funds were provided. Some of these programs have been reduced in scope, others deferred as we robbed them to get on with the more immediate tasks.

With your permission, I would like to deal briefly with the fundamentals of NASA's operations in terms of personnel, programs, and facilities. As you know, our budget is structured

into three accounts, Salaries and Expenses, Research and Development, and Construction and Equipment. The House reduction in the funds requested for the NASA affects in a significant manner vital parts of these operations and the detailed impact of these cuts will be described for you shortly in greater detail by my associates.

Dealing with the first of these categories, it is to be noted that the largest portion of our Salaries and Expenses account is allocated for the personnel requested to carry out NASA's aeronautical and space exploration responsibilities. If one merely looks at the statistical personnel growth in the organization--from 8,930 at the end of fiscal year 1959 to a planned 16,373 at the end of fiscal year 1961, a misleading picture may be provided. The facts of the situation reveal that the great majority of NASA's employees came to NASA through transfers of programs and activities to the new agency. From the National Advisory Committee for Aeronautics, from the Vanguard Program, from the Signal Corps, from the von Braun group, and such other related technical activities have come almost all of NASA's personnel. I should point out that the total given--16,373--does not include the 2400 employees of the Jet Propulsion Laboratory, transferred to NASA from the Army by

Executive Order, since they are not direct employees of the Federal Government--rather they operate under a contract between NASA and the California Institute of Technology of which you are aware.

I have consistently stated my opposition to an expansion in the Federal payroll at a rate beyond that required to carry out, largely by contract, the program thus far proposed by NASA and the Executive Branch and effectively approved by the Congress. In support of this position, I would point out that of the 9,745 persons on the NASA payroll as of May 1, 1960, -- not including the bulk of the Huntsville group who will transfer to NASA as of 1 July, next -- less than 600 can be considered new Federal employees. And of this number, approximately 400 have been new college graduates. So long as I have this responsibility, I will view with concern any substantial increase in governmental employment where the tasks to be accomplished can be contracted to industry and the universities unless, indeed, time and circumstances clearly dictate otherwise.

The bulk of our people--some 96 per cent of them--are or will be located at our seven Research and Space Flight Centers, at our Wallops Island Launching Station, or at the small liaison offices we maintain at the Atlantic Missile Range, our Western

Operations Office and later will establish at the Pacific Missile Range. As of 1 July 1961, we have planned to employ 683 persons, an increase of 75 over presently approved staffing levels, in our Washington headquarters unit. This number has been criticized and the total number of positions proposed for the agency has been reduced by 373 and the money available for Salaries and Expenses by \$4,260,000. Again, Mr. Chairman, I ask your leave in the interest of an orderly presentation to have these matters discussed in greater detail by my associates. I would point out, however, that the primary functions of the Headquarters Office is to provide responsible and competent program management of a rapidly growing organization whose activities are essential to the establishment of this country as a leader in the exploration of space. During the brief period that NASA has been in existence, the missions undertaken to carry out the assigned responsibilities have caused our budget to rise from a total of \$339 million in FY 1959, to a request for \$915 million in 1961.

We cannot, in good conscience, reduce our estimates for Headquarters personnel and at the same time conscientiously assert our determination to achieve an aggressive, well-balanced, well-managed program. Equally important is the matter of

staffing our Field Centers with a sufficient number of qualified technical and administrative people to carry out the program on which we are embarked. We need the 373 positions, Mr. Chairman, and we earnestly solicit the favorable action of your Committee in restoring the numbers originally requested.

In connection with NASA's research and development account, I have already referred to some of the pressures currently confronting us. Even though over two-thirds of our requested funds are to be obligated to these activities, we have grave doubts about our abilities to maintain our presently scheduled research activities and flight schedules with the funds estimated. Here again, the cuts proposed, while relatively small when viewed as a percentage of our total R&D request for funds, become an alarmingly large percentage of the amount within which we have freedom to maneuver.

Project Mercury enters a major operational phase during fiscal year 1961, with program launches at a rate of more than one a month. Here, the House has suggested a reduction of \$2,750,000. As you know, during each of the past two years, we have had to request supplemental appropriations for this important project. In our other major program areas -- sounding rocket research, scientific satellites, meteorology,

communications, vehicle development, tracking and data acquisition - the significant developments planned during the coming fiscal year will all be affected by the reduction voted by the House in NASA's funding requirements.

In our vehicle program, the area in which we are most deficient with our international competitor, we propose to expend almost half of our entire budget. A very substantial proportion of that amount -- probably substantially more than half -- will pay for development costs and development hardware to be used in subsequent years. The remainder provides for carrying pay loads into space during this particular fiscal year. On the other hand, we have presently found that during the development stage the per unit cost of vehicles which we propose to use for satellite and deep space flights, the Scout, Thor-Agena and Atlas Agena vehicles -- will be substantially more. For instance, the launched cost of the first production Scouts was estimated at \$700,000 and now is \$915,000; the Thor-Agena cost has increased by \$800,000 and the Atlas-Agena by \$1,500,000. With our heavy schedule of flights, these increases will add up to a substantial total. And we are not certain that these prices will hold.

In connection with the Centaur vehicle we are faced with the necessity for incrementally funding \$1,500,000 in fiscal year 1961 -- this is due to our decision to utilize the Centaur engine in the Saturn program.

We also must be able to find an additional \$5,500,000 for vehicles for our 1960 Lunar Exploration Program. As the Committee recalls, we had a failure in our planned circumlunar flight last Thanksgiving Day. We have been unable to date to identify any reduced costs in our program to cover the vehicles for the continued program in this area. But we must continue to look for such savings, or, in the alternative, defer the project to another time period.

In view of the facts just related, our problem is not merely the proposed reduction of so much money voted by the House -- it is in addition the very serious problem of finding the ways and means to carry out the planned program in the face of these and other increased costs which are sure to follow, the magnitude of which we do not now have a clear picture.

Finally, in our Construction and Equipment account, the programs we must press to attain our national objectives are directly connected to the availability of suitable facilities

to conduct our operations. Of the \$122,787,000 requested in this account, almost half is required to carry on the Saturn program and provide the laboratories and facilities needed by capable groups of scientists, engineers, and technicians at Huntsville, Alabama.

The balance of \$68,287,000 is required to cover Construction and Equipment needs for all our other research centers and facilities, as well as tracking and data acquisition. And I must point out that the NASA has continuing and heavy responsibilities in conducting aeronautical research and this program requires the maintenance and construction of modern facilities as well as our space activities.

Since we cannot expect our scientific personnel to perform at any better pace than our facilities permit them to perform, I am at a loss to understand how a reduction in test equipment, laboratories, or office facilities can fulfill the needs of the Nation in aeronautics or space exploration.

Members of the Committee, I have stated the case for NASA's appeal for restoration of funds as frankly as I can. My top associates will be providing you with additional information on our program and operations.

At the risk of becoming monotonous, I repeat, in closing, my statement of a year ago to this Committee. We must have the facilities, the money, and the personnel that will enable NASA to carry out its responsibilities of exploring this new frontier.

In the past, this Committee and the Senate have responded favorably to our urgent appeals for support of our full budgetary request. I continue to be confident that we can rely on you at this time to recognize the validity of our requests in the face of the competition from others and the challenge to our own ingenuity, determination and national well-being that can be satisfied only through an aggressive, well-planned space exploration program.

My associates, Dr. Dryden and Mr. Horner, are ready to present briefly but in greater detail the facts underlying the statements I have made. We shall then be happy to answer such questions as you may wish to ask of us. Thank you.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

HOLD FOR RELEASE UNTIL DELIVERY
Expected 10:00 a.m., Thursday, May 19, 1960

Statement by

Dr. Hugh L. Dryden

before the

Subcommittee on Independent Offices
of the
Senate Committee on Appropriations

Mr. Chairman and Members of the Committee:

We are requesting you at this time to help us continue the aggressive pace of the national program for the exploration of space which has been established during the past year. In April of last year we had been in existence only a few months and could only describe plans. Today we can cite past accomplishments.

For example, we then described to the NASA Authorization Subcommittee of the Senate Committee on Aeronautical and Space Sciences a meteorological satellite to be launched with television instrumentation and other radiation detection instrumentation.

This statement referred to Tiros launched successfully on April 1, 1960 with the television instrumentation alone which continues to

provide photographs of cloud formations all over the world.

Meteorologists tell us that the value of these photographs to their work has greatly exceeded their already high expectations.

We also described space probes then planned. We estimated 50 to 75 pounds as the payload of the Thor-Able vehicle as a space probe. On March 11th of this year Pioneer V was launched by Thor-Able IV. Its weight was 94 pounds, and its outstanding performance is well known. To date the probe has returned more than 100 hours of data on cosmic radiation, charged particle energies and magnetic field phenomena from distances up to ten million miles from the earth. These data have overturned well established theories about solar flare effects and have provided new information on the structure of the earth's magnetic field.

From these two examples it is seen that the time from decision on a certain flight mission to the actual conduct of the flight amounts to more than one year for launch vehicles based on existing rockets. When new launch vehicles of increased performance are involved, the lead time required is much longer. We must therefore make and we have made decisions on a launch vehicle program and on a series of objectives and flight missions. The execution of this program extends over several years. Since it involves research

and development in a new technology, unexpected factors make it impossible to forecast exact schedules and costs. Our estimates represent the best estimates we can make in the light of our past experience and do not include reserves for contingencies. Thus reduction of the funds made available below these estimates must result in slowing the pace of the program beyond that which may arise from unforeseen technical causes.

During the past year we have had many other successes and some unsuccessful launchings. Since May 1, 1959 NASA has attempted the launching of nine satellites and two space probes of which four satellite launchings and one space probe launching were successful. In each failure we have been able to determine the probable cause of failure and we have taken corrective action in subsequent flights. Six major non-orbital firings were made in the Mercury program, all successful.

The space flight program to be conducted during FY 1961 comprises three broad areas: (1) Manned space flight; (2) scientific investigations of space directed toward the knowledge of the control exerted by the sun over events on earth, the origin and workings of the universe, and the origin of life; and (3) early applications of the results of space exploration and investigation. The appropriation

request provides for vigorous prosecution of this flight program, for the earliest practicable development of a few types of reliable launch vehicles of greatly increased capability, for an adequate network of ground stations for tracking and telemetry, and for the necessary research and development to support an aggressive program.

The flight program for Project Mercury, our highest priority manned satellite program, includes six orbital flights in FY 1961 of capsules carrying instrumentation in the earlier flights and animals in the later ones. In FY 1962 there are scheduled five flights, and it is expected that one of these during the last half of the calendar year 1961 will carry the first U.S. astronaut into orbit and return him safely to earth.

The scientific satellite program for FY 1961 includes nine vehicles carrying instrumentation for advanced measurements on the ionosphere, gamma and cosmic rays, radiation belt and solar astronomy. The space probes include a lunar orbiter using the Atlas-Able launch vehicle with a backup flight schedule, and two probes to study interplanetary plasma, electric and magnetic fields.

The applications program includes one meteorological satellite and one passive communications satellite.

In summary, the FY 1961 space flight program includes 17 earth satellites and four lunar and interplanetary probes. A large part of the funding for these flights was provided in FY 1959 and FY 1960 because of the long lead times required. Thus more than 90 percent of the money provided in FY 1961 appropriation estimates for satellites and space probes is for missions to be flown in FY 1962 and beyond. These missions already planned and tentatively scheduled in FY 1962 and FY 1963 include 18 earth satellite missions and four lunar and interplanetary probes. In this time period we attain the ability to put as much as 5000 pounds in a 300 mile orbit with the Atlas-Agena B launch vehicle. Work on these payloads is already under way and must be accelerated. Two of the major satellites will contain respectively a stabilized astronomical telescope and a well equipped geophysical observatory, each operated remotely from the ground.

The key to accomplishment of many missions in space is the performance of the launch vehicle system. We are continuing to implement the policy of concentrating as quickly as possible on a small number of launch vehicles to obtain the increased reliability that comes from repeated firings of the same system. Because of the long lead times required for vehicle development, as much as

five years for Saturn even under accelerated funding, the implementation of this policy requires several years. However in FY 1961 the last Juno II and Atlas-Able vehicles will be fired and in FY 1962 Thor-Agena B and Atlas-Agena B will come into use. The last interim Thor-Delta will be fired in FY 1962 and the current appropriation estimates carry the final funding of this vehicle. The current estimates before you continue the rapid development of the Centaur and Saturn vehicles. The Centaur is scheduled for first NASA launch in FY 1962 and the first launching of a two-stage Saturn vehicle comes in FY 1963.

In FY 1961 we expect to continue projects in propulsion technology to provide the basis for vehicles of still greater capability. The principal new rockets to be under development in FY 1961 are the 1,500,000-pound-thrust, single-chamber F-1 engine, the 200,000-pound-thrust, hydrogen-oxygen engine to be used in upper stages of Saturn, a 6000-pound-thrust, storable propellant engine for extended missions in deep space, and the Rover nuclear rocket under joint development by AEC and NASA. Our position in space activities in the 1965-1970 period will be determined by the success of these developments and of the launch vehicles based on their use.

Because of the long lead time to which I have frequently referred it is necessary to have a long-range plan covering many years and to implement this plan with persistence and with adequate resources. As the Administrator has said, during the past year NASA has prepared and placed before the Congress and the nation a plan for the next ten years of space exploration. The specific objectives of this plan are most conveniently summarized by stating the anticipated growth of spacecraft size in terms of the weight of the largest individual spacecraft which can be placed in a 300-mile earth orbit in each year of the next decade, the anticipated major vehicle launching schedule and the mission target dates.

The term spacecraft is used to denote that part of the space vehicle intended to be placed in an earth orbit or launched into space on a departure trajectory. The spacecraft includes the useful payload in the form of scientific instruments, power supply, telemetry, the structural assembly and covering, and any necessary guidance, attitude controls, and propulsion to be used for maneuvering in space after launch. During the next ten years the spacecraft weight for this near-earth satellite mission increases from 100 pounds of the Juno II to more than 50,000 pounds. In the early years the increases occur as the Thor-Agena B, Atlas-Agena B, and Atlas-Centaur come

into use. In the 1963-67 period Saturn and its successively improved upper stages will account for our increased capability.

The launch schedule shows the previously mentioned reduction of the number of launch vehicle types to five within a few years. The level of activity contemplates about 30 major launchings per year, but, as mentioned above, the spacecraft weight soon becomes much greater than those now available. The cost of the spacecraft will soon exceed that of the vehicle and the lead times for their development will increase considerably.

The NASA mission target dates may be briefly summarized as follows. In calendar year 1960 we have launched the meteorological satellite Tiros and we have attempted a launch of a passive communications satellite using the first Thor-Delta vehicle. We hope to reach these targets successfully this year as well as the first launching of a Scout vehicle and the first suborbital flight of an astronaut. Many of the other mission dates have already been mentioned in connection with FY 1961 funding. The later missions include the first launching of an unmanned vehicle for controlled landing on the moon in calendar year 1963, and the first launching in a program leading to manned circumlunar flight and to near-earth space station in the 1965-1967 time period.

This plan will be revised annually; in fact a revision has been started to be completed this fall. It is probable that the plan outlined will require support at a level upwards of \$1-1/2 billion annually within the next few years. Its steady prosecution is essential to the welfare and security of the United States.

The resources available to NASA for the conduct of this program consist of physical facilities and manpower within NASA itself and in U.S. industry and universities. The one resource which provides and supports the others is the money appropriated annually by the Congress. During FY 1961 more than two-thirds of the funds appropriated to NASA will be used to finance work by American industry under contract. This proportion will become even greater in future years as increasing dependence is placed on industry for the accomplishment of development work.

The personnel resources of NASA have been provided largely by the assembly of existing organizational units within the government having the capabilities and experience required for space exploration. Thus 8040 staff members of the laboratories and headquarters of the former National Advisory Committee for Aeronautics, the 400 members of the Vanguard team of the Naval Research Laboratory and the 5500 members of the former Development Operations Division of

the Army Ballistic Missile Agency at Huntsville, Alabama account for 13,940 members of the present staff. During the first two years of NASA's existence an additional 1646 positions were added to provide technical and scientific skills not present in the assembled group but needed to give a balanced staff for the new business of space exploration. A further increase of 887 positions is required in FY 1961 to be applied to the needs of the Goddard Space Flight Center and the Wallops Station. In this period during which the personnel increased by a factor of two, the funds appropriated increased by a factor of nine. Of the total of 16,373, 4.2 percent or 683 persons are required for the headquarters staff in Washington. Even with this number the development and implementation of a complex and highly technical program in the entirely new field of space exploration and its coordination with the work of other interested government, scientific and industrial organizations require long hours and intensive effort by members of the headquarters staff. Without this group our space activities would consist of a series of unrelated and uncoordinated projects. With them we attain a unified national program. The number requested corresponds to the long-term needs of a stabilized program, and is not geared to the greater interim needs of the present period.

The resources needed to implement the national program include facilities as well as people. The research centers of the former NACA were transferred to NASA and constituted its first facilities. Many of you are familiar with them.

The oldest and largest, the Langley Research Center near Hampton, Virginia, conducts research in structures and materials for missiles and space vehicles, aerodynamics of reentry vehicles, aircraft aerodynamics, and fundamental research in plasma physics. The initial cost of its present facilities was about \$154 million. In FY 1961 a staff of 3220 will conduct research at a total program cost of about \$38 million.

The Lewis Research Center at Cleveland, Ohio is devoted to propulsion research with programs on chemical rockets with emphasis on high energy propellants, nuclear rockets, electric propulsion, and electric power generation for spacecraft. In FY 1961 a staff of 2736 will conduct research at a total program cost of about \$35 million. The facility investment there is \$148 million.

The Ames Research Center, Moffett Field, California will conduct in FY 1961 a research program with a staff of 1440 at a cost of about \$19 million in space environmental physics, gas dynamics at extreme speeds, automatic stabilization, guidance, and control

of space vehicles, and full-scale research on vertical takeoff and landing craft. The facility investment is about \$107 million.

The Flight Research Center, at Edwards, California will devote most of the efforts of its staff of 416 in FY 1961 to flight research on the X-15 research airplane which can experience the characteristics of space flight for a duration of a few minutes.

The facilities for the support of space flight research with satellites and space probes include three space flight centers, and three locations at which we have some facilities for launching space vehicles. In addition we have networks of tracking stations around the world to track and record data from satellites and space probes.

The Goddard Space Flight Center has primary responsibility for those projects concerned with sounding rockets and earth orbiting satellites, including Project Mercury, and the applications of satellites for meteorology and communications, as well as the scientific satellites. The nucleus of this staff was the Navy Vanguard group. The staff at Goddard will grow to 2000 in FY 1961. Currently housed in several buildings in the Washington area and at the Langley Research Center, its staff will begin occupancy of facilities now under construction at Greenbelt, Maryland during the coming summer.

The Jet Propulsion Laboratory at Pasadena, California, has primary responsibility for those projects concerned with spacecraft for exploration of deep space, lunar and interplanetary probes. This laboratory is utilized by NASA through contract with the California Institute of Technology and will have a staff of about 2400 engaged in the NASA program. The physical plant was largely constructed by the Army and title to it was transferred to NASA shortly after NASA was established.

The launch vehicle development and operation responsibility will be assigned to the George C. Marshall Space Flight Center at Huntsville, Alabama. The final stages of transfer of these facilities and personnel from the Army will be effected on July 1 of this year. We have had the full technical and program responsibility for several months.

A missile firing laboratory is maintained at the Atlantic Missile Range and during FY 1961 a small group of liaison people will be located at the Pacific Missile Range, both groups reporting to the Marshall Center. Sounding rockets and Scout satellites will be launched at Wallops Station on the Atlantic coast of Virginia. A staff of 300 people operates an \$18 million facility. This station will be the scene of launchings made in cooperation with other nations in our program of international cooperation in space activities.

The fundamental resources available to carry out the program are the funds to be appropriated for FY 1961. The total amount requested was \$915 million, \$170,760,000 for salaries and expenses, \$621,453,000 for research and development, and \$122,787,000 for construction and equipment. This breakdown corresponds approximately to the amounts for the annual operation of the inhouse resources, for the contracted part of the conduct of the program of space exploration, and for capital expenditures. The breakdown by program is as follows: Space flight \$370,132,000; launch vehicle \$403,023,500; advanced research \$129,379,000; program direction \$12,465,500. This last item, amounting to 1-1/2 percent of the total budget, supports the headquarters and certain liaison and coordinating activities throughout the United States. Mr. Horner will describe to you in some detail the effects of the reduction in funds, facilities, and manpower by the House action. Substantial modification and slowdown of the research and development program are inevitable unless full restoration is made.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

HOLD FOR RELEASE UNTIL DELIVERY

Expected 10:00 A.M., Thursday, May 19, 1960

Statement of Richard E. Horner, Associate Administrator
before the
Subcommittee on Independent Offices
of the
Senate Committee on Appropriations

Mr. Chairman and Members of the Committee:

The Administrator and the Deputy Administrator have provided you with a resume of our program in space exploration, discussed our accomplishments of the past year, explained what we intended to do with the funds we requested for the next fiscal year, and requested a complete restoration of the funds that were eliminated in H. R. 11776. The Committee on Appropriations, in reporting the bill to the full House of Representatives, suggested many specific reductions in program items and in a few cases complete elimination. It is my privilege to explain to this Committee the effect that these decreases in funding support will have in the areas where they are identified, and try to provide some understanding of their effect on the overall program. It is my objective to convince you that such reductions are completely inconsistent with our constantly increasing responsibilities in a field which is undeniably important to our nation's prestige, and promises ever-increasing returns for the dollars invested, both in the practical applications of space experimentation and in the burgeoning technology which the space program supports.

Dr. Dryden has discussed with you our most significant accomplishments in the past year and informed you of our intended objectives of the next decade. From his remarks it is obvious that our program is still in its infancy but there are a few facts which we have learned to be indisputable, and I believe they are important in this discussion.

First, the practice of space exploration requires the most sophisticated application of the physical, engineering, and life sciences that can be brought to bear, if an acceptable level of success is to be achieved with a reasonable investment. It is clear that the immeasurable volume of space offers so much attractive opportunity for experimentation and exploration that even the great wealth of this nation must be applied in a carefully planned, well integrated, consistently supported program. The alternative is a frightful waste of our national resources.

Another fact which emerges is the recognition that any substantial development in the space program requires years of effort before it bears fruit in recognized accomplishment. Recognizing this long lead time nature of our work is another prerequisite to understanding the chaos which is created by vacillating financial support and the uncertainty resulting from delaying this year's budget request until next year's supplemental appropriation. We have been asked, for example, why our technical staffs at our field centers are not reduced pending the completion of new research facilities as our program requirements change. Such questions reflect a serious lack of understanding. Our scientific and technical research staffs are our most precious commodity. They constitute the foundation of our entire program in advanced research and perform the essential function of the extensive contract development effort. The quality of this staff has been

built over the past forty years as elements of other organizations. It would be scarcely less than criminal negligence on our part to seek short term economy by not providing stable support to them. Staff members of such competence could hardly be persuaded to ever rejoin the Government laboratories if they were discouraged from remaining on the job each time the budget pendulum swung low in their particular area of work.

Still another fact which is undeniably clear from our brief experience is that space experimentation is a very expensive business. We constantly seek methods of improving our program efficiency and especially to improve the reliability of our space flight efforts. We think we are making progress, but each success leads to even more difficult missions. And an accurate measure of their difficulty is their dollar cost. It is abundantly clear that the choice for the nation is well defined. If a comprehensive, energetic and competitive program of space exploration is the will of our country, the required financial resources must be made available. The alternative is to accept, indeed to expect, substantial delays in reaching the program objectives which have been laid out. I wish to assure you again we will be hard put to meet these objectives on the time scale we have even indicated/if we are provided with all of the resources that we have requested. To provide less than has been requested makes delays in some elements of the program a certainty and these delays, I am sure, will be attractive to none of us. With these few general remarks, I would now like to discuss the suggested reductions individually and in some detail.

The House bill provides for a reduction of \$4,260,000 in the salaries and expenses account of the requested budget. The exact application of this reduction is not stipulated, except that an approximate reduction of 16% is directed in the expenses of travel, and allowance has been made for 373 less staff positions than were requested.

The increasing need for travel expenses in our program implementation is incident to three causes. On the first day of the next fiscal year we will assume the responsibility of the new Marshall Space Flight Center at Huntsville, Alabama. This installation will be the largest single field center in the NASA organization, with a staff of 5500 employees. Their program of launch vehicle development is largely carried out by contract and of course must be carefully coordinated with the operations of our other field centers. I believe the need for staff travel expenses in this connection is obvious. Even beyond the needs of the Marshall Center, our entire development contracting program is developing rapidly. Industrial firms, universities and non-profit institutions throughout the United States are prosecuting elements of the program which must be carefully coordinated to avoid gross inefficiencies. The third reason for increasing travel requirements is our expanding worldwide network of tracking and communication stations. The ability of the United States to place these facilities in every quarter of the globe on the soil of friendly nations overseas, as well as within our own boundaries, constitutes a major advantage over our rival behind the Iron Curtain, an advantage I am sure that we would not think of giving up. Yet it does require extensive traveling for many members of our staff to get these stations properly equipped and operational in a carefully integrated

network. Of course it is desirable to hold the movement of people to a minimum that is consistent with program efficiency. Our budget request reflected this philosophy, and to reduce it further runs a severe risk of costing millions in program mismanagement in order to save thousands through reduced travel expenses.

As regards the suggested reduction of staff numbers, it is noted that the House Committee is critical of the staffing level which is proposed for the Washington headquarters of our organization, both in the numbers of staff positions and in the salary grades, thus, presumably, in the competence that is provided. To comment usefully on this suggested reduction, it is necessary to observe that we have adopted a concept of organization which assigns discreet functional areas of responsibility to each of our field centers. For the centers engaged in the advanced research program, there have been designated technical areas in which they specialize. At the space flight development centers, there is an even higher degree of specialization. At the Marshall Space Flight Center, for example, all of our launch vehicle development work is located. Likewise, the Jet Propulsion Laboratory has the responsibility for the development of spacecraft to be used in deep space exploration. And the Goddard Space Flight Center has the mission of developing and operating spacecraft to be used in earth orbital trajectories. This organization of our work is highly effective in bringing to bear the best qualified and most highly interested talent on specific technical disciplines with a minimum of duplication and overlapping in assignments. But obviously it puts a premium on competent program direction and correlation from the top.

The essentiality of the launch vehicle and the spacecraft both arriving at the launch pad at approximately the same time and each being compatible with the other, is obvious. But this happens only with understanding program control and not by accident. If one considers the needs of this very complex problem of program coordination, together with the requirements for total program planning, the process of budget formulation, the interaction with the Executive and Legislative branches of the Government, the program coordination with the Department of Defense, and the many other duties of management involved in an effort as complex and as large as the nation's space program, it seems to me that our request for a headquarters staff of 683 persons is modest indeed. That they should be as competent as we can possibly obtain, and therefore requiring of a senior grade structure, seems to speak for itself.

Since the proposed increase in the headquarters staff was only 75 positions, and the total reduction was 373, it is obvious that most of the decrease in staff authorizations was intended to be taken at the field centers, and presumably at the Goddard Space Flight Center, since that was the organization for which the greatest increase in new hiring was requested. Here it is again necessary to mention that this is the center charged with responsibility for the largest portion of our spacecraft development contracting. Proper exercise of our custodial responsibility over public funds does not seem to be well served by slighting the staff requirements at this location. As a matter of fact, this inconsistency is most apparent in an actual quotation from the House Committee report in discussing the research and development

account. I would like to quote. "The Committee directs that closer attention be given to contractor costs. This is the field that invites the most waste." It is not apparent how such closer scrutiny can be exercised except with the use of competent Government staff members in adequate numbers.

In the research and development account as a whole, the House bill proposes a reduction from the budget request of \$19,213,000. Of this amount, \$5,135,000 is proposed as a reduction in the requested amount for the support of the NASA plant. This account provides funds for the supplies, materials and equipment that are used by the professional staff of the NASA centers in doing their work. The quality and total contribution of this staff is directly a function of the adequacy of this support. Here, again, it is a case where a little false economy can be extremely costly. The pressures of our development schedules and contract hardware program are strong influences to keep this support at the minimum essential level that we requested. Further reductions would be most unwise.

A reduction of \$5,000,000 is proposed in the House bill on the level of support for research grants and contracts. It is through this program that we have been able to bring the efforts of the nation's most eminent scientists in American universities and non-profit institutions to bear on our space program. Neither the House bill nor the report of the Appropriations Committee provides any rationale for this suggested cut. But to accept this restriction means that we would be unable to capitalize on any research results which might indicate new channels of exploration without making a corresponding reduction in the on-going and currently supported work.

Furthermore, it is essential to expand considerably our research in the life sciences. We have recently created the nucleus of the organizational component which will manage this work, and most of the program for the immediate future will be supported with money from this account. The work is essential if NASA is to fulfill its responsibilities as enumerated by the Congress. It cannot be accomplished without proper financial support.

The balance of the reduction from the budget request that was made by the House action on the research and development account amounted to a total of \$9,078,000. It was spread over seven different program areas, while eight others were provided with the full amount requested. There is no explanation provided in the report of the committee, and it is impossible to discern the reasoning which lay behind these reductions. There was one illuminating comment concerning Project Mercury, which indicates that the reduction on that project of \$2,750,000 is intended to be a token reduction. This, of course, is the project which has enjoyed our highest priority almost since its inception. Its purpose is to demonstrate the feasibility and the utility of manned space flight at the earliest possible date that is consistent with the safety of the passenger in the vehicle. We are very conscious of the need for providing the greatest possible assurance against loss of life while maintaining the earliest possible schedule that is consistent with this need. I am sure that you would all agree with us that it would be unthinkable to in any way compromise the safety factor for lack of needed funds. In addition, we are quite conscious that this is an important national prestige item in our program and the recent accomplishments of the Soviet Union can scarcely increase our comfort as regards our comparative positions. With these circumstances, we can only ask: Is this the time

to start handicapping our efforts with token reductions in the required support?

In other areas there was a reduction of \$400,000 in sounding rockets. These are the vehicles which provide the most efficient method known for measuring the physical characteristics of space near the earth in its vertical cross section. Scientific satellites, such as Explorers VI and VII, which have been so prolific in providing a better understanding of space phenomena in the past year, have come in for a reduction of \$1,700,000. Our efforts in meteorology are to be reduced by \$1,200,000 -- while the world acclaims the accomplishment of Tiros I, and its pictures offer the first real and practical benefits to mankind from the space program. Our program in worldwide communications, to be accomplished using passive reflector satellites, was reduced by \$200,000; and the program in vehicle systems technology by \$1,200,000. The incongruity of this reduction is apparent if one notes that the entire amount requested for launch vehicle development was allowed, but the effort to adapt new techniques for improvement and utilization of these vehicles is reduced by six percent.

Finally, the program to install and operate the worldwide network of tracking and data acquisition equipment was reduced by \$1,628,000. This element of our program, of course, provides the link between our spacecraft in flight and the scientists on the ground. There can be little reward from successful space flight without adequate ground tracking and data acquisition.

As we have mentioned many times previously, our brief history has proven conclusively that research and development programs tend to experience cost

increases over the estimated values rather than decreases. We provide in our budget request no contingency funds to meet such increases, and the cumulative effects of small reductions in each of several program areas will almost certainly have a pronounced effect on some of the program elements. It should be noted that in no instance did the House Committee assume that we had erred in making our estimates too low. We do not claim to be superhuman in anticipating precisely the trends of this very complex program. But it is hardly reasonable to assume that we would make all of our mistakes in the same direction when it comes to cost estimating.

In the construction and equipment account, the House bill effected a reduction of \$15,512,000. Four specific construction projects were deleted, all provisions of funds for fall-out shelters were left out, and unspecified reductions of \$8,018,700 were made with no more than an observation of surprise at the high square foot cost of construction for the buildings as they were proposed.

At the Jet Propulsion Laboratory the provision for a publications, library, and technical services building was denied. As I have mentioned previously, it is at this laboratory that the responsibility for our deep spacecraft development and operations is centered. To carry out this highly sophisticated work, a staff of more than 600 research scientists and professional engineers are employed. To deny these professional staff members adequate facilities for preparation of reports, the maintenance of a technical library, and provisions for photographic and reproduction services, is to deny them the tools of their trade and jeopardize their effectiveness.

At the Marshall Space Flight Center, the completion of the guidance and control building, and an addition to the fabrication laboratory, are both essential to the development of the Saturn launch vehicle. The funds for the central laboratory and office facility are also denied, and this, too, is a facility which is badly needed for the continuation of work at the center. Since the NASA was directed to take over responsibility for the super booster development and assimilate the Development Operations Division of the Army Ballistic Missile Agency, we have been in almost continuous discussion with the Department of the Army to determine the best means of accommodating the accelerated development schedule of the Saturn vehicle, together with the other launch vehicle development responsibilities which must be assumed by Dr. von Braun's group, while at the same time the Army carries out its essential functions. To assure an objective evaluation of the facilities problem at the Marshall Center, the General Services Administration was asked several months ago to make a complete survey of all the buildings available. The results of this survey that are now available show that even after maximum utilization of all the buildings provided, the Marshall Center will clearly require the additional office space we requested. It is clear that temporary and makeshift arrangements involving the conversion of unused warehouses and the use of temporary buildings will be necessary for an interim solution. The result will be a scattered staff and difficult organizational relationships. The efficiency of this very important field center should not be jeopardized for extended periods of time.

As regards the provision for fall-out shelters, the NASA is of course not expert in this field and our budget requests were based on the Government

policy for such consideration in all new Federal buildings. I think it is pertinent to observe that if the nation is to have a fall-out shelter program, and there seems to be a great deal of sentiment supporting such a program, how can it be better forwarded than by the example of the Federal Government. Furthermore, it is difficult to imagine a more economical or a better organization of such provisions than by the method of providing for them in the initial construction of each new building.

In the unspecified reduction of slightly more than \$8,000,000 the House Committee offered the only explanation concerning square footage costs that I mentioned earlier. In the construction of scientific laboratories, thermodynamic facilities, static test stands, and launch pad blockhouses, cost per square foot is not a meaningful criteria. Those of you who have seen the static test stand for the Saturn launch vehicle at the Marshall Space Flight Center, for example, will recognize the validity of this statement.

The estimates we have provided in our budget request are as realistic as a staff with long experience in designing research facilities knows how to make them. Our experience with construction costs, like that with costs of research and development, does not lead us to believe that our estimates are too high. And here again, the long lead time required for design, construction and equipping, denies the wisdom of procrastination.

I have tried to provide for the Committee's information a specific explanation of the effects of each of the proposed reductions in the Appropriations Bill of the House of Representatives. Budget estimating,

like space exploration, is an exact science in only some few of its elements. We do not claim infallibility in making these estimates. We do think we are making effective use of the resources that are made available to us. We have been under great pressure to advance the space program at an even greater rate than we have proposed. We also feel strongly our responsibilities as custodian of the public dollar. Under these circumstances we expect to continue to budget tightly and are confident that the Congress would not want us to make allowances for systematic discounting of our estimates. We can pledge no more than an energetic prosecution of the program at the rate for which resources are provided. We recognize that in the final analysis, it is the responsibility of the Congress, as representatives of the American people, to establish that rate.

*Sent to House & Senate
Space Committee Staffs*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

Office of Public Information

May 20, 1960

MEMORANDUM TO EDITORS:

Enclosed are the first in a new series of International Space Activity Summary charts for use as reference and background materials. Collectively, these charts will replace the statistical summary issued periodically by NASA, which has become more and more cumbersome as the number and variety of satellite and probe launchings has increased.

These charts are designed to be easily filed in a ring binder or jacket.

The system has four major sections for ease in filing and reference, with different colored paper determining the proper section. Paper colors are:

- White -- U. S. Satellites
- Canary yellow -- U. S. Probes
- Blue -- U. S. Manned Spaceflight
- Green -- Foreign Space Activities

Each chart carries a key on the upper right hand edge. The key will begin with one of these four letters:

- S-U. S. Satellites
- P-U. S. Probes
- M-U. S. Manned Spaceflight
- F-Foreign Space Activities

The letter is followed by the year of launch, and then by order of launching. For instance, in the first charts enclosed, there are six separate pages. Five are white, indicating U. S. Satellites; one is yellow, indicating a U. S. probe. The white charts are keyed consecutively from S-60-1 through S-60-5. The probe is keyed P-60-1. Any revisions to the original charts, such as when a vehicle comes down or ceases transmission, would be keyed with a letter (e.g., S-60-1A).

Issuance of the charts begins with the first six launches of 1960. You will receive next the remaining 1960 launches. We then will work back through the 1959, 1958 and 1957 activities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

Office of Public Information

May 20, 1960

INTERNATIONAL SATELLITE AND SPACE PROBE SUMMARY

The following space vehicles are in orbit as of this date:

<u>NAME/COUNTRY</u>	<u>LAUNCH DATE</u>	<u>TRANSMITTING DATA</u>
Explorer I (US)	Jan. 31, 1958	No
Vanguard I (US)	March 17, 1958	Yes
*Lunik I (USSR)	Jan. 2, 1959	No
Vanguard II (US)	Feb. 17, 1959	No
*Pioneer IV (US)	March 3, 1959	No
Explorer VI (US)	August 7, 1959	No
Vanguard III (US)	Sept. 18, 1959	No
Lunik III (USSR)	Oct. 4, 1959	No
Explorer VII (US)	Oct. 13, 1959	Yes
*Pioneer V (US)	March 11, 1960	Yes
Tiros I (US)	April 1, 1960	Yes
Transit IB (US)	April 13, 1960	Yes
Sputnik IV (USSR)	April 15, 1960	Yes

*In Solar Orbit; others in earth orbit.

CURRENT SUMMARY (May 20, 1960)

Earth Orbit: US- 8
USSR- 2

Solar Orbit: US- 2
USSR- 1

Transmitting: US- 5
USSR- 1

COMPLETE SUMMARY (Launched to Date)

Earth Orbit: US- 18
USSR- 5

Solar Orbit: US- 2
USSR- 1

Lunar Impact: USSR- 1

SPACE ACTIVITIES SUMMARY

DISCOVERER IX

Project: Discoverer IX Project Direction: U. S. Air Force Launched: 1:51 a.m. EST, February 4, 1960 From: Vandenberg AFB, California Lifetime: Not Applicable	Major Objectives: Satellite system to gather data on propulsion, communications, orbital performance and stabilization, recovery techniques. Major Results: Orbit not achieved due to ground equipment malfunction.*
<p style="text-align: center;">Flight Program</p> <p>Launch Vehicle: Thor-Agena. Stages: (1) Modified Thor IRBM. (2) Agena.</p> <p>Lift-Off Weight: 108,500 lbs. (Approx.) Dimensions: 78 ft. high, 8 ft. base diameter.</p> <p>Program: Place satellite in near-polar orbit and recover capsule.</p> <p>Program Results: Failed to achieve orbital velocity. No recovery attempt.*</p> <p>Perigee (Miles): Not Applicable Inclination: Not Applicable Apogee (Miles): Not Applicable Period: Not Applicable</p> <p>Velocity: Not Applicable</p>	
<p style="text-align: center;">Payload And Instrumentation</p> <p>Dimensions: 19.2 ft. high, 5 ft. diameter Payload Weights: 1,700 total lbs., includes second stage casing and 300-lb. capsule.</p> <p>Payload Configuration: Cylindrical</p> <p>Instrumentation: Includes data capsule to be ejected from satellite by timing device; retrorocket and parachute to slow descent. Radio beacon, radar chaff and rotating high-frequency stroboscopic light for recovery.</p> <p>Transmitters:</p> <p>Power Supply:</p>	
<p>Additional Data: * Failure to achieve orbital velocity attributed to malfunction in tower which moves fueling equipment from space vehicle. Resulting damage to second stage caused premature shutdown of first stage.</p>	
<p>Sources: USAF</p> <p style="text-align: right;">Date: Prepared May 20, 1960</p>	

S-60-1

DISCOVERER IX

SPACE ACTIVITIES SUMMARY

DISCOVERER X

Project: Discoverer X	Major Objectives Satellite system to gather data on propulsion, communications, orbital performance and stabilization, recovery techniques.
Project Direction: U.S. Air Force	
Launched: 3:14 p.m. EST, February 19, 1960	
From: Vandenberg AFB, California	
Lifetime: Not Applicable	Major Results: Orbit not achieved. Vehicle destroyed by Range Safety. *

S-60-2

Flight Program**Launch Vehicle:** Thor-Agena. Stages: (1) Modified Thor IRBM. (2) Agena.**Lift-Off Weight:** 108,500 lbs. (Approx.)**Dimensions:** 78 ft. high, 8 ft. base diameter.**Program:** Place satellite in near-polar orbit and recover capsule.**Program Results:** Failed to achieve orbital velocity. No recovery attempt. ***Perigee (Miles):** Not Applicable**Inclination:** Not Applicable**Apogee (Miles):** Not Applicable**Period:** Not Applicable**Velocity:** Not Applicable**Payload And Instrumentation****Dimensions:** 19.2 ft. high, 5 ft. diameter**Payload Weights:** 1,700 lbs. total, includes second stage casing and 300-lb. capsule.**Payload Configuration:** Cylindrical**Instrumentation:** Includes data capsule to be ejected from satellite by timing device; retrorocket and parachute to slow descent. Radio beacon, radar chaff and rotating high-frequency stroboscopic light for recovery.**Transmitters:****Power Supply:****Additional Data:** *Vehicle rose from launching pad as programmed but veered off course at 20,000 ft. Destroyed by Range Safety Officer 52 seconds after launch.**Sources:** USAF**Date:** Prepared May 20, 1960

DISCOVERER X

SPACE ACTIVITIES SUMMARY

MIDAS I

S-60-3

Project: Midas I Project Direction: U.S. Air Force Launched: 12:25 p.m. EST, February 26, 1960 From: Atlantic Missile Range Lifetime: Not Applicable	Major Objectives Overall test of system for detection of missile launchings with satellite-borne infrared sensors. Major Results: Orbit not achieved due to malfunction of vehicle.*
<p style="text-align: center;"><i>Flight Program</i></p> <p>Launch Vehicle: Atlas-Agena. (1) Modified Atlas ICBM. (2) Agena "A".</p> <p>Lift-Off Weight: 260,000 lbs. (Approx.) Dimensions: 99 ft. high, 16 ft. base diameter.</p> <p>Program: Place satellite in Earth orbit.</p> <p>Program Results: Re-entered atmosphere after 2,500-mile flight. No orbit.</p> <p>Perigee (Miles): Not Applicable Inclination: Not Applicable Apogee (Miles): Not Applicable Period: Not Applicable</p> <p>Velocity: Not Applicable</p>	
<p style="text-align: center;"><i>Payload And Instrumentation</i></p> <p>Dimensions: 22 ft. high, 5 ft. diameter Payload Weights: 4,500 lbs. total weight for orbit. (Entire second stage.)</p> <p>Payload Configuration: Cylindrical</p> <p>Instrumentation: Full details not released. Includes infrared, telemetry and communications equipment.</p> <p>Transmitters: Not Available</p> <p>Power Supply: Not Available</p>	
<p>Additional Data: * Atlas performed as programmed. Presumption is that second stage separation failed to occur and vehicle was destroyed on re-entry.</p> <p>Midas program designed to lead to operational system in which infrared sensors provide warning of enemy missile launchings.</p>	
<p>Sources: USAF</p> <p style="text-align: right;">Date: Prepared May 20, 1960</p>	

MIDAS I

SPACE ACTIVITIES SUMMARY

EXPLORER

S-60-4

Project: Explorer**Project Direction:** NASA**Launched:** 8:35 a.m. EST, March 23, 1960**From:** Atlantic Missile Range**Lifetime:** Not Applicable**Major Objectives** Analyze electron and proton radiation energies in the radiation zones over extended period of time.**Major Results:** Orbit Not Achieved.**Flight Program****Launch Vehicle:** Juno II. Stages: (1) Modified Army Jupiter IRBM. (2) 11 scaled-down Sergeant rockets. (3) Three scaled-down Sgt. (4) Single scaled-down Sgt.**Lift-Off Weight:** 120,000 lbs.**Dimensions:** 76 ft. High, 8-3/4 ft. Diameter.**Program:** Place satellite in highly elliptical Earth orbit.**Program Results:** Orbit not achieved. Ground stations lost communication after second stage burnout.**Perigee (Miles):** Not Applicable**Inclination:** 28° from Equator**Apogee (Miles):** Not Applicable**Period:** Not Applicable**Velocity:** Not Applicable**Physical Characteristics****Dimensions:** See Below**Payload Weights:** 35.3 lbs., including 12.5 fourth stage casing, 22.8 lb. instrument pack.**Payload Configuration:** Cylinder 21 in. long surrounded by 9x12-in. solar cell array. Aluminum shell.**Instrumentation:** Five radiation experiments for detection and counting of electrons and protons. Temperature sensors. Telemetry.**Transmitters:** 300 mw at 108.03 MC capable of transmitting data continuously on 5 channels.**Power Supply:** Nickel cadmium batteries recharged by 1184 solar cells.**Additional Data:** Satellite was designed for 200-mile perigee and 33,000-mile apogee for broad coverage of radiation belts.**Sources:** NASA**Date:** Prepared May 20, 1960

EXPLORER

<p>Project: Tiros I (1960 Beta)</p> <p>Project Direction: NASA</p> <p>Launched: 6:40 a.m. EST, April 1, 1960</p> <p>From: Atlantic Missile Range</p> <p>Lifetime: Est. 50-100 yrs. (Useful lifetime est. 3-5 mos.)</p>	<p>Major Objectives Test of experimental television techniques leading to eventual worldwide meteorological information system.</p> <p>Major Results: Successful launch into near-circular orbit; video system relayed thousands of pictures containing cloud-cover photographs of meteorological interest.</p>
<p style="text-align: center;">Flight Program</p> <p>Launch Vehicle: Thor-Able. Stages: (1) Modified USAF Thor IRBM; (2) Liquid engine modified from Vanguard; (3) Solid motor modified from Vanguard.</p> <p>Lift-Off Weight: 150,000 lbs. (Approx.) Dimensions: 90 ft. high, 8 ft. base diameter.</p> <p>Program: Place satellite into circular orbit; photograph cloud cover over many areas of the world.</p> <p>Program Results: Successful. Programmed goals attained.</p> <p>Perigee (Miles): 428.7 Inclination: 48.32° to Equator</p> <p>Apogee (Miles): 465.9 Period: 99.19 min.</p> <p>Velocity: 24,654 ft./sec. at third-stage burnout.</p>	
<p style="text-align: center;">Payload And Instrumentation</p> <p>Dimensions: 19 in. high, 42 in. diameter. Payload Weights: 270 lbs. total</p> <p>Payload Configuration: "Pillbox" shape covered on top and sides by 9,200 solar cells. Three pair of spin rockets and transmitter antenna surround baseplate. Receiving antenna on top center. Aluminum/stainless steel shell.</p> <p>Instrumentation: One wide and one narrow angle camera, each with tape recorder for remote operation. Picture data can be stored on tape or transmitted directly to ground command stations.</p> <p>Transmitters: Picture information is transmitted by two 2-watt FM at 235MC; two tracking beacons operate on 108 and 108.03 MC with 30 mw out put.</p> <p>Power Supply: Nickel cadmium batteries charged by solar cells.</p>	
<p>Additional Data: Tiros combines the initials of Television Infra-Red Observation Satellite. Later models will have sensors to map relative temperatures of the Earth's surface. Early photographs provided new information on cloud systems including spiral formations associated with large storms.</p>	
<p>Sources: NASA</p> <p style="text-align: right;">Date: Prepared May 20, 1960</p>	

SPACE ACTIVITIES SUMMARY

PIONEER V

<p>Project: Pioneer V (1960 Alpha)</p> <p>Project Direction: NASA</p> <p>Launched: 8 a.m. EST, March 11, 1960</p> <p>From: Atlantic Missile Range</p> <p>Lifetime: Est. 100,000 years.</p>	<p>Major Objectives: Investigate interplanetary space between orbits of Earth and Venus; test extreme long-range communications; study methods for measuring astronomical distances.</p> <p>Major Results: All objectives achieved. Established significant "firsts" in long-range communications, gauged solar flare effects, particle energies and distribution, and magnetic field phenomena in interplanetary space.</p>
<p style="text-align: center;">Flight Program</p> <p>Launch Vehicle: Thor-Able IV. Stages: (1) Modified USAF Thor IRBM. (2) Liquid rocket modified from Vanguard. (3) Solid rocket modified from Vanguard.</p> <p>Lift-Off Weight: 105,000 lbs. (Approx.) Dimensions: 90 ft. high, 8 ft. diameter.</p> <p>Program: Place instrumented space probe into heliocentric orbit between the orbits of Earth and Venus.</p> <p>Program Results: Objectives achieved.</p> <p>Perigee (Miles): 74.9 million from Sun. Inclination: 3.35 degrees to Ecliptic.</p> <p>Apogee (Miles): 92.3 million from Sun. Period: 311.6 days</p> <p>Velocity: 24,689 mph at third-stage burnout.</p>	
<p style="text-align: center;">Payload And Instrumentation</p> <p>Dimensions: 26 in. sphere plus four solar vanes. Payload Weights: Total, 94.8 lbs. Includes approx. 40 lbs. of instruments.</p> <p>Payload Configuration: "Paddlewheel" -- sphere plus four vanes covered by 4800 solar cells.</p> <p>Instrumentation: High-energy radiation counter, ionization chamber and Geiger-Muller tube for measurement of plasmas, cosmic radiation and charged solar particles. Magnetometer. Micrometeorite impact counter. Aspect indicator. Temperature measurements.</p> <p>Transmitters: Two UHF operating at 378 MC. Five-watt transmitter for initial data read-out. 150 watt transmitter for long-range.</p> <p>Power Supply: Solar vanes & cells for charging 28 nickel-cadmium batteries.</p>	
<p>Additional Data:</p>	
<p>Sources: NASA</p> <p style="text-align: right;">Date: Prepared May 20, 1960</p>	

P-60-1

PIONEER V

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

WASHINGTON 25, D. C.

May 24, 1960

TO EDITORS:

The attached speech by Dr. Homer E. Newell, Deputy Director of the NASA's Office of Space Flight Programs, is for your background information and files. It was presented in Japan on May 24, 1960 at the International Symposium on Rockets and Astronautics, sponsored by the Japanese Rocket Society, Tokyo.

Release No. 60-202

THE U.S. NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION'S SPACE RESEARCH PROGRAM*

by

Homer E. Newell

May 1960

ABSTRACT

The United States National Aeronautics and Space Administration is developing a broad program of aeronautics and space research. Included in the program are the development of vehicles for space flight, the development of advanced technology, aeronautics research, applications of space research and technology results to practical problems, manned flight and human exploration of space, and scientific investigations of the earth's atmosphere and space. The space program will involve about 100 sounding rocket firings per year for the next few years, plus roughly 9 scientific satellites and near-earth probes per year, plus about 4 deep space probes per year. The development of an international cooperative program is being vigorously pursued, and on the operational side extensive cooperation is already under way in radio and optical tracking of satellites and probes, and in the preparation of the Mercury range. Specific cooperative programs in atmospheric and space science have already been developed, and many others are under discussion. It is the hope of NASA that a truly world-wide international program may be developed including cooperation between the United States and the USSR.

*Prepared for presentation to the International Symposium on Rocket and Astronautics, sponsored by the Japanese Rocket Society, Tokyo, Japan, May 1960.

THE U. S. NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION'S SPACE RESEARCH PROGRAM*

by

Homer E. Newell

May 1960

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION.....	1
THE SPACE SCIENCE PROGRAM.....	6
<u>Vanguard III (1959 Eta)</u>	8
<u>Explorer VII (1959 Iota I)</u>	12
<u>Pioneer V (1960 Alpha)</u>	15
<u>Future Plans</u>	22
SATELLITE APPLICATIONS.....	24
<u>Tiros I (1960 Beta)</u>	24
INTERNATIONAL COOPERATION.....	26
<u>Acknowledgements</u>	31

* Prepared for presentation to the International Symposium on
Rocket and Astronautics, Sponsored by the Japanese Rocket
Society, Tokyo, Japan, May 1960

TABLE OF CONTENTS (Continued)

<u>Tables:</u>	<u>Page</u>
1. U.S. Sounding Rockets.....	3
2. U.S. Satellites and Space Probes for Space Science Investigations.....	7
3. Vanguard III Earth Satellite (1959 Eta).....	9
4. Explorer VII Earth Satellite (1959 Iota I).....	13
5. Pioneer V Deep Space Probe (1960 Alpha).....	16
6. NASA Space Science Experiments Planned as of 1 April 1960.....	23
7. TIROS I Earth Satellite (1960 Beta).....	25

Figures:

1. U.S. Satellite and Space Probe Vehicles.
2. Payload and Mission Capabilities.
3. The Scout Launching Rocket.
4. The Vanguard III Earth Satellite.
 - 4.1 Vanguard III Magnetic Field Results.
5. Explorer VII Earth Satellite.
 - 5.1 Radiation Belt Observations from Explorer VII (1959 Iota I).
 - 5.2 Atmospheric Radiation Balance Results from Explorer VII.
6. The Pioneer V Deep Space Probe.
7. TIROS I Weather Observation Satellite.
8. Weather Picture Taken by the TIROS Satellite.
9. Weather Picture Taken by the TIROS Satellite.
10. Weather Picture Taken by the TIROS Satellite.

INTRODUCTION

The United States National Aeronautics and Space Administration has now been in business for about a year and a half. Created under the Space Act of 1958, which became law on July 28, 1958, the NASA was given the job of continuing and extending the work of the older National Advisory Committee for Aeronautics, and of developing and carrying out a national space program. The Act declared "that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind". The Act further set forth eight objectives of aeronautical and space activities of the United States, including the expansion of human knowledge of atmospheric and space science, and the use of space knowledge and technology for practical applications.

There are many technical activities in NASA. The Administration took over the activities, facilities, and personnel of the 40-year old National Advisory Committee for Aeronautics. Thus, a large part of the NASA program is comprised of aeronautics and related research. This activity includes not just aeronautics in the classical sense, but also advanced research directed toward the space age. The X-15 aircraft is an example of the combination of rocketry and aeronautics. In the laboratory, research is devoted to improved materials and their use, advanced propulsion techniques, and advanced instrumentation.

NASA has a strong program of vehicle development and launching in support of its space activities. About a dozen different types

of sounding rockets are in use or under development. Typical of these are the rockets listed in Table 1.

The NASA vehicle program also includes 12 types of satellite and space probe vehicles. With the exception of the Redstone, these are shown in Figure 1. This relatively large number of launch vehicles resulted from the availability of ballistic missiles systems already developed for military missions. Seven of the vehicles are considered to be of an interim or relatively short term use and will be discontinued by about 1963. Four others, the Scout, Atlas-Agena-B, Atlas-Centaur, and Saturn, -- form the backbone of the long-range satellite and space probe programs. Nova is, at the present time, a vehicle concept included in the very long-range plans.

The vehicles included in the NASA program will provide a build up of payload and mission capabilities during the next ten years, illustrated in the drawing of Figure 2. This capability is expressed in terms of the payload weight that can be placed in a near-earth satellite orbit. Such capability can, however, also be expressed in terms of the capabilities for space probe missions, for example, to the moon or to the planets. As is seen from the figure, there will be a progressive rise from 1960 through 1962, then a substantial jump in payload capability with the coming of the Saturn vehicle. It is anticipated that there will be a continued rise in payload capability through 1969, accompanying the projected Saturn growth.

Table 1U. S. SOUNDING ROCKETS

<u>Vehicle</u>	<u>Cost</u> (Thousands of dollars)	<u>Capability</u>	
		<u>Altitude</u> (mi./km)	<u>Payload Weight</u> (pounds)
Aerobee 100 (Aerobee Jr.)	20	60/95	100
		80/130	40
Arcon	6	45/70	50
		75/120	16
Nike-Asp	9.5	80/130	200
		190/305	20
Aerobee 150, 150A (Aerobee H1)	29	110/175	300
		180/290	120
Aerobee 300 (Spaerobee)	36	220/355	130
		450/725	20
Argo D-4 (Javelin)	50	690/1111	90
		1075/1730	10
Argo D-8*	130	1600/2575	100
		2600/4185	20

*Preliminary figures, based on feasibility and design studies.

The Scout is of especial interest in that it is intended to be a relatively inexpensive multi-purpose vehicle. As shown in Figure 3, the Scout is a four-stage solid propellant rocket. Because of its simplicity, the rocket can be launched from inexpensive launching facilities. It can be used to carry a large variety of scientific payloads, such as high altitude probes, re-entry models, and satellites. It will place a 200 pound payload in a 300 nautical mile (550 km) circular orbit, or will project a 50 pound vertical probe to 12,000 nautical miles (22,000 km). Thus, the Scout may be regarded as intermediate between the sounding rocket and the deep space probe, while at the same time being a useful satellite launching vehicle.

Using the vehicles described above the NASA is conducting a broad program of research on the earth's atmosphere and spatial environs. As rapidly as possible this research is being extended into the depths of space, to the moon, and the planets. It is planned to apply satellite techniques to the field of astronomy, so that observations of the stars and galaxies may be made free from the obscuring and distorting effects of the earth's atmosphere. The NASA space program also includes life sciences research, a particularly exciting aspect of which will be the search for extraterrestrial life.

The NASA program includes work on advanced technology. Examples are the development of advanced chemical-propulsion

systems, nuclear propulsion, electrical propulsion, nuclear and solar power supplies, and advanced guidance and control systems for space applications. There is also research on life support systems required for keeping man alive in space.

A very important facet of NASA's program is the application of space science and technology results to practical uses. At the present time, this includes research on the use of satellites for meteorological observations, for communications, and for geodetic measurements.

Finally, the NASA program includes manned exploration of space. In the course of time, it is expected that this program will include manned flight at the edge of the earth's atmosphere, manned orbital flight in the vicinity of the earth, and eventually flight to the moon and planets. At present, the initial steps toward such space exploration are being taken in Project Mercury. This project is directed toward the early achievement of orbital flight using techniques, equipment, and vehicles that are either already available, or available with a minimum of development. As must be the case in all manned flight projects, the engineering program for Project Mercury is directed toward the achievement of the utmost reliability before a man is to be committed to actual flight. Project Mercury by no means involves the ultimate in manned space flight; rather it is to be regarded as a first step toward later space explorations.

THE SPACE SCIENCE PROGRAM

The NASA program in space science has grown out of activities of the past 13 or 14 years, including the International Geophysical Year. It involves the use of sounding rockets, earth satellites, and space probes to investigate the earth, its atmosphere, its environment, and the objects and phenomena of outer space. The sounding rocket program continues at a pace comparable to that of the International Geophysical Year, and covers the broad area covered during the past dozen years in various programs of the Department of Defense. No attempt will be made here to review past firings in detail.

Satellites and space probes launched by the United States for space science investigations are listed in Table 2. Those launched after the first of October 1958, were under the auspices of the National Aeronautics and Space Administration. In them, the NASA has continued the work begun in the early Explorers and Vanguard. Extensive results from the early satellites and space probes have already been reported in the literature, and I am sure that these are well known to this audience. Exciting results continue to appear, particularly from the latest satellites and space probes. I shall attempt here to summarize, without detail, some of the latest results that have been reported.

Table 2

U.S. SATELLITES AND SPACE PROBES
FOR SPACE SCIENCE INVESTIGATIONS

October 1958 to April 1960

<u>VEHICLE</u>	<u>LAUNCH DATE</u>	<u>EXPERIMENT</u>
<u>Earth Satellites:</u>		
Explorer I	31 Jan 58	Cosmic Rays; Micrometeors.
Vanguard I	17 Mar 58	Test.
Explorer III	26 Mar 58	Cosmic Rays; Micrometeors.
Explorer IV	26 Jul 58	Radiation Belt.
Vanguard II	17 Feb 59	Cloud Cover.
Explorer VI	7 Aug 59	Radiation Belt and Cosmic Rays; Magnetic Field; Micrometeors; Very Low Frequency Radiowave Propagation; Single Line Tele- vision Scanner.
Vanguard III	18 Sep 59	Magnetic Field; Solar X-rays; Micrometeors.
Explorer VII	13 Oct 59	Solar Ultraviolet and X-ray Radiations; Cosmic Rays; Earth Radiation; Micrometeors.
<u>Space Probes:</u>		
Pioneer I	11 Oct 58	Radiation Belt; Magnetic Field; Micrometeors; Television Scanner.
Pioneer III	6 Dec 58	Radiation Belt.
Pioneer IV	3 Mar 59	Radiation Belt.
Pioneer V	11 Mar 60	Radiation Belt; Particles and Cosmic Rays in Space; Magnetic Fields; Micrometeors.

Vanguard III (1959 Eta)

The satellite Vanguard III was the last of the Vanguard International Geophysical Year satellites to be launched. Descriptive information about Vanguard III is contained in Table 3. The satellite itself is shown in Figure 4.

Although the lifetime in orbit of Vanguard III is estimated to lie between 30 and 40 years, the equipment was powered for only about 3 months of operation. After 86 days the satellite became silent. During the interval of operation, the proton precessional magnetometer provided a comprehensive survey of the earth's magnetic field throughout the range of altitudes and latitudes covered by the Vanguard orbit; namely, within the belt from 33.4° N latitude to 34.4° S latitude geographic, and from 510 to 3750 km. Dr. Heppner has provided the following summary of the magnetic field results to date from the Vanguard III data:

"Although reduction of Vanguard III magnetic field data is only 50 percent complete, preliminary analyses have provided considerable information concerning the earth's main field. Over large regions of the Western Hemisphere, Australia, and South Africa it is now possible to state the absolute value of the total magnetic field intensity to a high accuracy. This information has been especially valuable in illustrating both the strong and weak points in existing descriptions of the magnetic field by spherical harmonic analyses.

Table 3

Vanguard III Earth Satellite
(1959 Eta)

<u>Launch Date</u> <u>(Lifetime)</u>	<u>Dimensions</u>	<u>General Shape</u>	<u>Weight</u> <u>(pounds)</u>	<u>Initial</u> <u>Perigee</u> <u>(miles)</u>	<u>Initial</u> <u>Apogee</u> <u>(miles)</u>	<u>Initial</u> <u>Period</u> <u>(minutes)</u>	<u>Inclination</u> <u>(degrees)</u>
18 Sep 59 (30 to 40 years)	20 inches diameter (51 cm)	Sphere with 26 inch tapered tube extension; plus empty third stage.	100 (45 kg)	319 (513km)	2329 (3748 km)	130	33.4

Experiments

Proton precessional magnetometer.
Solar X-rays.
Micrometeor detectors.
Thermistors.

Experimenters

Goddard Space Flight Center (Heppner).
Naval Research Laboratory (Friedman).
Goddard Space Flight Center (LaGow).
Goddard Space Flight Center (LaGow).

"In the most recent analysis, evidence was found that a magnetic field discontinuity exists at the lower edge of the inner radiation belt at magnetic latitudes greater than 25 degrees. Work is under way to make sure that this discontinuity is real and not the result of an unknown peculiarity in orbit computation. There is additional evidence for one or more discontinuities in lower latitude regions but it is felt that more data will have to be processed for confirmation.

"The study of measurements taken during magnetic storms shows that the field disturbance observed by the satellite is strongly dependent on the location of the satellite. At magnetic latitudes greater than 25 degrees the satellite disturbance is often considerably larger than that observed on the ground when the satellite is located near the lower edge of the inner radiation belt or in the 'radiation slot' that bounds the inner belt at its northern and southern limits. On the other hand, measurements taken within the inner belt at these latitudes appear to be relatively undisturbed during storms. This is illustrated in Figure 4.1. The numbers indicate the time sequence of the measurements during the storm. Measurements 7, 8, 9, and 12, which were not disturbed, were taken during the maximum of the main phase of this magnetic storm. Measurements 6, 10, and 11, also during the main phase maximum were disturbed with the same sign as the ground disturbance. Measurements 14, and 16 which occurred later in the storm were

strongly disturbed but with a sign opposite to that of the ground disturbance. (The two undisturbed points at low altitude over Woomera, Australia can be ignored here as they coincide with short periods when the ground disturbance was very small). In equatorial regions, where it is first essential that one remove electrojet influences, a clear picture of storm effects has not as yet been obtained. When this is accomplished a better understanding of the unexpected results at higher latitudes is expected."

Because the Vanguard III satellite spent so much of its time in the Van Allen Radiation Belt, the Naval Research Laboratory ionization chambers for observation of solar X-rays were saturated much of the time. Although this prevented investigation of the solar X-rays, nevertheless the chambers did provide a considerable amount of detail on the location of the lower edge of the Radiation Belt, which could be determined from the locations at which the counters either went from nonsaturated to saturated condition or vice versa.¶ The micrometeorite data was collected over a period of 78 days by counting the impact vibrations. About 3700 impacts were counted over this period, with the largest influx level occurring during the month of November. The estimated mass of the impacting particles was greater than 3.3×10^{-9} g. The density of this component of dust is computed to be 7×10^{-22} g. cm⁻³, approximately the same as measured from Explorer I. The two pressure zones were not punctured, and no measurable amount of erosion was detected on the photodetector and the chromium strip experiments.

Explorer VII (1959 Iota I)

Explorer VII was launched by a Juno II rocket on October 13, 1959. This satellite was the last of the satellites planned as part of the International Geophysical Year program. It was the most complex and diversely instrumented of the satellites planned for IGY, and had come to be known colloquially as "the Heavy IGY" or "composite radiation" satellite. Descriptive information on Explorer VII is given in Table 4. A photograph of the Explorer VII satellite appears in Figure 5.

The following material from the experimenters on Explorer VII has been provided by the satellite project manager, H. LaGow:

"Telemetering signals have already been recorded for more than seven months from 1959 Iota. Many of the records have not yet been collected, processed, distributed and analyzed but many significant geophysical results have already been reported by the experimenters. The principal results reported to date, include:

- (1) The State University of Iowa measurements of time and spatial variations in the outer radiation zone show interesting correlations with other geophysical observations. Figure 5.1 shows (a) a stable outer radiation zone on 27 November; (b) a very disturbed outer zone on 28 November during a severe magnetic storm; and (c) a narrow 3-second wide peak at 0336.30Z on 28 November over an observed auroral arc.

Table 4

Explorer VII Earth Satellite (1959 Iota I)

<u>Launch Date</u> <u>(Lifetime)</u>	<u>Dimensions</u>	<u>General Shape</u>	<u>Weight</u> <u>(pounds)</u>	<u>Initial</u> <u>Perigee</u> <u>(miles)</u>	<u>Initial</u> <u>Apogee</u> <u>(miles)</u>	<u>Initial</u> <u>Period</u> <u>(minutes)</u>	<u>Inclination</u> <u>(degrees)</u>
13 Oct 59 (20 to 30 years)	30 inches high (76 cm) 30 inches dia- meter (76 cm)	Toroid	91.5 (41.5kg)	345 (555 km)	678 (1091 km)	101.3	50.3

Experiments

Lyman-alpha and X-ray solar radiation detectors.
Ionization chamber for heavy cosmic rays.

3 Micrometeor detectors.
2 Geiger-Mueller tubes.
Earth radiation balance measurements.

Experimenters

Naval Research Laboratory (Friedman).
Martin Co. RIAS* (Groetziner and Schwed),
Bartol Research Foundation (Pomerantz),
Goddard Space Flight Center (LaGow).
State University of Iowa (Van Allen).
University of Wisconsin (Suomi).

*Research Institute for Advanced Studies

(2) A drastic modification of the outer zone on 31 March to 10 April 1960, commencing with the great magnetic storm on 31 March. Intensity levels went from a nominal 200 counts/second down to less than 10 and up to over 10,000 counts/second on the State University of Iowa experiment. Pioneer V also detected an increased counting rate of soft radiation on 31 March at some 5×10^6 km from the earth.

(3) The Bartol-RIAS heavy primary cosmic ray experiment reveals that the integral flux varies approximately as the inverse first power of the magnetic rigidity and that during the 11 days immediately following launch, the flux of heavy primary cosmic rays remained constant within the statistical uncertainties of measurements over the entire range of rigidities covered.

(4) The Army Ballistic Missile Agency temperature measurements which show that temperatures have stayed within the design limits of 0-60°C during the first 185 days after launch. During this period the satellite has gone through two periods when the satellite was in sunlight 100 percent of its orbital period.

(5) The first micrometeorite penetration of a sensor in flight. A Goddard Space Flight Center cadmium sulphide detector was exposed to sunlight after the penetration of

its evaporated aluminum coating on a 1/4 mil thick Mylar film only 5 mm in diameter.

(6) The detection of large scale weather patterns by the University of Wisconsin radiation balance experiment. Figure 5.2 shows isolines of rate of heat loss from top of atmosphere as measured by 1959 Iota. The area shown is between Hawaii and the mainland of the United States at 10° N latitude. It is covered with cold air or high clouds."

Pioneer V (1960 Alpha)

The deep space probe Pioneer V was launched on 11 March 1960 at 8:00 a.m. EST. Descriptive information on Pioneer V is contained in Table 5. At first perihelion passage it is estimated that Pioneer V will be 46 million miles from the earth.

The Pioneer V space probe is equipped with a solar-cell nickel-cadmium battery power supply and a digitized telemetry system capable of indefinite operation. A 5-watt transmitter is carried in the payload for relaying the data and information from the satellite during the initial portion of the trajectory. With the 250 foot dish at Manchester, it is estimated that contact with the payload could be maintained until about 20 million miles (32 million km) from the earth; however it was planned to switch the transmission from 5-watts to 150-watts at an earlier time, and this has been done. With the 150 watt transmitter operating, it is estimated that the Manchester dish can maintain contact with the payload

Table 5

Pioneer V Deep Space Probe (1960 Alpha)

<u>Launch Date</u> <u>(Lifetime)</u>	<u>Dimensions</u>	<u>General Shape</u>	<u>Weight</u> <u>(pounds)</u>	<u>Perihelion</u> <u>(million miles)</u>	<u>Aphelion</u> <u>(million miles)</u>	<u>Period</u> <u>(days)</u>	<u>Inclination</u> <u>To Ecliptic</u> <u>(degrees)</u>
11 Mar 60 (in orbit about sun)	26 inch (66 cm) diameter	Spherical with extended solar cell paddles.	94.8 (43 kg)	74.9 (121 M. km)	92.3 (149 M. km)	312	3.35

Experiments

High energy radiation proportional counter.
Ionization chamber, Geiger-Mueller tube.
Search coil magnetometer.

Micrometeor counter.

Experimenters

University of Chicago (Simpson).
University of Minnesota (Winckler).
Space Technology Laboratories (Sonett
and co-workers).
Air Force Cambridge Research Center
(Cohen) and NASA (Dubin).

to distances in excess of 50 million miles (80 million km), perhaps to as much as 90 million miles (145 million km) from the earth. The operation of the Pioneer V payload is commanded on and off by signals from ground stations in Hawaii and in Manchester, England. For the 5-watt transmitter, the duty cycle of the operation is somewhere between 8 and 9 percent of the total time. As of the end of April 1960, more than a hundred hours of telemetering operation had been recorded. By that date, the probe was approaching the 7 million mile (11 million km) mark from the earth.

Many exciting results have been obtained by Pioneer V. They extend observations made from earth satellites in previous Pioneers. Many of the observations correlate with observations made at the earth's surface; some of the results from Pioneer V are related to results obtained in Explorer VII which is still functioning. The following information on Pioneer V results has been provided by the experimenters and the NASA project manager, John Lindsay.

The first two weeks following the launching of Pioneer V were relatively free of solar activity. At the end of March, however, from March 27 to April 6, 1960 there was a period of high solar activity. During this time, the space probe was in the vicinity of 5 million kilometers from the earth and approximately in the plane of the ecliptic. On March 31, at 0800 universal time, there began a severe magnetic storm on

the earth, which was accompanied by major earth current disturbances, a complete blackout of the North Atlantic communications channel, and auroral displays. Simultaneously a large Forbush decrease occurred in the galactic cosmic radiation. From measurements made in Pioneer V, J. A. Simpson and his co-workers report the following results:

(1) At the time of the March 31, 1960 Forbush decrease in the vicinity of the earth, a similar decrease occurred at Pioneer V. The decrease at 5 million kilometers from the earth was at least as great as that at the earth. Hence, existing theories for this phenomenon requiring the presence of the earth and its magnetic field are proved to be invalid.

(2) On April 1, 1960, not only protons but electrons and/or gamma rays from the sun were observed. At the same time, Leinbach reported polar cap absorption of radio noise. The time relations between these two observations were such as to indicate that the solar flare particles producing the ionization in the polar atmosphere over a period of many hours were not stored in the geomagnetic field nor at the sun.

(3) Simpson and co-workers also report evidence for the solar production of energetic electrons by processes other than solar flares. Bremstrahlung was measured in Pioneer V for many days of the period over which data are presently available.

Winckler and co-workers report the following results from the integrating ionization chamber and geiger counter in the space probe. During the interval of high solar activity, in at least five cases flares produced a response of the Pioneer instruments within a few hours. These responses can be identified as low energy solar cosmic rays of the type observed previously on many occasions and reported in the literature. The largest cosmic ray bursts occurred on April 1 accompanying a class 3^+ flare beginning at 0830 universal time, and on April 5 associated with a major radio disturbance. The cosmic ray bursts have the following properties:

- (1) The sizes range from just detectable above galactic cosmic ray background to particle fluxes ten times galactic background.
- (2) The observed ion/count ratio is consistent with a differential energy spectrum of the form $E = CE^{-4}$, with a lower spectrum limit of about 40 mev.
- (3) The decrease of the particles in space seems definitely more rapid than that associated with simple diffusion.
- (4) Balloon observations at Minneapolis on April 1, 1960, during the large flare, showed the presence of solar protons of energy up to 400 mev. The flux and spectrum were consistent with the Pioneer V results.

(5) Three of the cosmic ray events observed at Pioneer V produced polar blackouts as reported by Leinbach at College, Alaska.

(6) Two of the cosmic ray events were also detected by counters on Explorer VII, and the particle fluxes are in good agreement with those obtained from Pioneer V.

Comparing Pioneer V observations with results from Explorer VII, and also from Explorer VI, Winckler reports that the electron flux observed in Pioneer V at great distance from the earth is only 10^{-4} that observed in the outer radiation belt at its maximum build-up following the initial depletion occurring at the time of the magnetic storm. The conclusion is that the great increase in the 50 kev electrons observed by Van Allen and co-workers in the outer zone on April 2 to 7 was not due to direct solar injection. Hence, there must be some local acceleration of a portion of a solar plasma cloud spectrum associated with the observed magnetic storm and Forbush event. It is this local acceleration of a portion of the plasma in the magnetic field of the earth that builds up the outer radiation zone.

A search coil magnetometer was carried aboard Pioneer V. C. P. Sonett and co-workers of the Space Technology Laboratories report the following results. The sensitivity of the search coil appears to be a few tenths of a gamma. The undisturbed magnetic field in space is about 2.5 gamma, but at the onset

of solar activity values as high as 40 gamma have been measured. From about 10 to 15 earth's radii, there exists an intense zone of magnetic field disturbance, appearing as waves in highly ionized distant regions from the earth. These observations confirm similar results obtained in Pioneer I. They indicate a collapse of the geomagnetic field at distances greater than 13 earth radii from the earth. The shapes and magnitudes of magnetic field fluctuations in space at a great distance from the earth are quite similar to the magnetic field variations observed at the surface of the earth during magnetic storms. The data from Explorer VI and Pioneer V indicate the existence of a ring current about the earth whose cross section is centered at an altitude of 10 earth's radii from the earth, and covers a region in space extending from approximately 7 to 13 earth's radii. Sonett and co-workers estimate the total current flowing inside this region of space to be about 5 million amperes. It is surmised that the ring current most probably consists of low energy particles, and for this reason has gone unobserved in the high energy detectors customarily used to investigate radiation belt particles.

Dubin reports that count data are being obtained from the micrometeor counter. Peculiarities of these data, however, indicate that the equipment may be malfunctioning. It is, therefore, not clear at the present time whether useful data will be obtained from this experiment.

Future Plans

NASA plans for continuation of the space science program, as recently presented to Congress, are reflected in Table 6. These plans reflect the present intentions of NASA. They are, of course, subject to change and modification as the program unfolds. It is intended at the appropriate time to announce the frequencies which will be radiated from the satellites, so that experimenters around the world may prepare observing equipment for using these frequencies for the study of the ionosphere and earth's upper atmosphere. It is also intended, where it can usefully be done, to make available to observers around the world the telemetering codes for various satellites, so that the scientists who wish to do so may participate in the collection of telemetered data and in the analysis thereof. It is clearly not possible or useful to do this for all satellites and space probes, but in those cases in which other observers around the world can usefully participate, every effort will be made to make the codes available. This will be done through the U.S. National Academy of Sciences, who will in turn make them available to the Committee on Space Research of the International Council of Scientific Unions.

Table 6

NASA SPACE SCIENCE EXPERIMENTS
PLANNED AS OF 1 APRIL 1960

<u>Mission</u>	<u>Number</u>	<u>Experiments</u>
Sounding Rockets	100/yr	Atmosphere; Ionosphere; Energetic Particles; Magnetic Field; Astronomy; Special.
Earth Satellites	4 or 5/yr	Ionospheric Properties; Gamma and Cosmic Rays; Ionospheric Beacon; Solar Spectroscopy; Atmospheric Structure; Geodesy; Ionospheric Topside Sounder; Radiation Belt; International; Polar Radiation; Polar Atmospheric Structure; Polar Ionospheric; Polar Geophysics; Sun-Earth Relations; Geophysics; Astronomical Observatory.
Space Probes	Sev/yr	Two Ionospheric Structure; Nuclear Emulsions; Outer Atmosphere Winds; Interplanetary Plasma; Magnetic Field; Energetic Particles; Magnetic Fields in Space; Interplanetary Environment; Technological Development; Lunar Surface Properties.

SATELLITE APPLICATIONS

As stated earlier, the NASA is actively exploring the possible applications of space research results and space technology to practical uses. Foreseeable applications of space techniques are to be found in the use of satellites for weather observation, for radio communication, for geodesy, and for navigation. TIROS I, launched this spring, was part of the meteorological program.

Before proceeding to describe the TIROS satellite, it should be emphasized that this is in no way to be regarded as an operational system. At this stage, the TIROS satellite is part of a research program, designed to explore what sort of data can be acquired by means of satellite techniques, and what use can be made of those data. An extremely important part of this research effort is to determine what can be learned from the cloud cover pictures obtained from TIROS, and where possible to relate photographic observations to measurements of the heat balance obtained by the Explorer VII scientific satellite, and other observations made with sounding rockets and balloons. Only after the proper groundwork has been laid by such research activities, can one proceed to the designing and development of a truly operational meteorological satellite system.

TIROS I (1960 Beta)

The TIROS I weather satellite was launched into orbit on April 1, 1960. Descriptive information concerning TIROS is contained in Table 7. A photograph of TIROS I is shown in Figure 7.

Table 7

TIROS I Earth Satellite (1960 Beta)

<u>Launch Date</u> <u>(Lifetime)</u>	<u>Dimensions</u>	<u>General Shape</u>	<u>Weight</u> <u>(pounds)</u>	<u>Initial</u> <u>Perigee</u> <u>(miles)</u>	<u>Initial</u> <u>Apogee</u> <u>(miles)</u>	<u>Initial</u> <u>Period</u> <u>(minutes)</u>	<u>Inclination</u> <u>(degrees)</u>
1 Apr 60 (20 to 30 years)	42 inches (107 cm) dia- meter 19 inches (48 cm) high	Cylinder	270 (122.5 kg)	429 (690 km)	466 (750 km)	99	48.3

Experiment

Cloud Cover Television.

Experimenter

Radio Corporation of America

The full significance to weather research, and ultimately to the development of practical weather observing systems, must await the study and analysis of the pictures obtained by the satellite borne television cameras. In the meantime, the pictures obtained speak graphically for themselves. Several such pictures are shown in Figures 8 thru 10.

INTERNATIONAL COOPERATION

By its very nature, science is universal, international. The history of science is a continuing record of international cooperation on a voluntary basis. The ideas and insights that have advanced science to its present day status have not been, nor are they now, the prerogative of any single country. Advancing ideas have come from every quarter of the globe.

Recognizing the great importance of widespread cooperation in the conduct of space science, the National Aeronautics and Space Administration intends to participate extensively in international programs of space research. In fact the National Space Act calls for "cooperation by the United States with other nations and groups of nations in work done pursuant to this Act, and in the peaceful application of the results thereof . . .". During the first year and a half of its existence NASA has taken many steps in the development of an international cooperation in space activities.

In order to provide for aggressive support of international objectives within NASA in response to the Congressional mandate, the Administrator established the Office of International Programs. It is the function of this office to generate, to encourage, to coordinate, and to provide necessary supporting services for NASA's cooperative activity. The following statement, made recently by the Director of the Office of International Programs will highlight the principles that NASA is following in this area:

"We feel that programs of international cooperation should be substantive in character, contributing toward the technical and scientific objectives of space research. This suggests that the programs themselves should grow out of, or be capable of integration with, NASA's own operating and research programs. But we do not wish to suggest to other nations' scientists what projects or programs they should adopt, or indeed, that they should enter into space research at all. If cooperation is desired, however, we are eager to discuss the possibilities. In such cases, we believe that consideration should be given to specific, limited projects, for it is too early in this new science to chart broad general programs. The essential criterion should be that the projects have scientific or technical validity. We would hope that proposals would represent experiments or other projects which we ourselves would wish to carry out if they were not to be done jointly.

"Generally speaking we cannot at this time consider programs which would involve an exchange of funds. Rather, each nation should be able to support its own contribution. However, it is not necessary that contributions be of equal scope and magnitude. Beyond these particular points, it goes without saying that the free exchange of information, and especially the results of our experiments should be made available to the scientists of all nations. To this end we support the activity in the United Nations regarding the peaceful uses of outer space. Similarly we are, through our National Academy of Sciences, giving full support to the International Committee on Space Research (COSPAR), one of the permanent offshoots of the International Committee for IGY (CSAGI)."

At the present time, NASA's international cooperative program involves many different types of activities. These include cooperation in the tracking and telemetry of satellites and space probes, including Project Mercury, and cooperation in planning for, preparing for, and carrying out scientific experiments in the atmosphere and outer space. The pattern of these various cooperations varies from country to country. NASA has been holding discussions with representatives of many countries, exploring the best way to develop a cooperative program in each individual case. In the case of space research, only a few programs have become active as of

the present time. On the other hand, out of the considerable amount of discussion that is underway, it is hoped active co-operative programs will arise.

Within a very few months of its establishment, NASA was engaged in preliminary technical discussions with representatives of the Canadian Defense Research Board on a proposed joint project to sound the ionosphere from above. The Canadians will also provide the antenna and satellite shell required. Meanwhile, NASA will develop a fixed frequency sounder. Both are scheduled for launching attempts by the United States. Tracking installations will be modified to acquire data from both, and a coordinated ground-based net will simultaneously probe the ionosphere from below. The British have expressed interest in this phase of the project; thus, a multilateral experiment is already in preparation and will be conducted sometime in 1961.

In March 1959, NASA authorized the National Academy of Sciences' delegate to COSPAR to offer, on behalf of the United States, to launch individual experiments or complete satellite payloads prepared by scientists of other nations. Because the closest possible collaboration is desirable in such efforts, it was stated that the experimenters were welcome to work together with American teams in the development of their projects.

In July, the United Kingdom sent a team to the U.S. under Prof. H.W.S. Massey to discuss a United Kingdom proposal within the framework of NASA's offer to COSPAR. It was tentatively agreed

that British scientists, over a two to four year period, would instrument perhaps three satellites for launching, probably by means of NASA's Scout vehicle. Each nation assumes responsibility for its own contribution. Specific proposals for four experiments to be flown in the first joint satellite were agreed upon in January of 1960. They will involve studies of solar radiation, electron density and temperature, and cosmic radiation. These will permit unique correlations of the on-board experiments themselves as well as between these and ground-based or air-space experiments. An exchange of notes at the government level will formalize this arrangement. The proposed experiments were communicated to COSPAR in January and have been endorsed by that Committee.

The two cooperative programs described serve to illustrate what can develop in this important and exciting area. The final arrangements may or may not be consummated by formal governmental agreements. Certainly if the expenses involved are considerable, as they may well be in the space research business, then governmental agreements are required. On the other hand, if the cooperative effort under discussion is of a limited nature, it may well be appropriate to make arrangements and carry out the program jointly between NASA and an appropriate agency within the cooperating country. In either case, NASA feels that the actual cooperative agreement should be preceded by informal technical discussions between the working levels in the countries involved, in order that specific cooperative projects may be clearly defined. It is

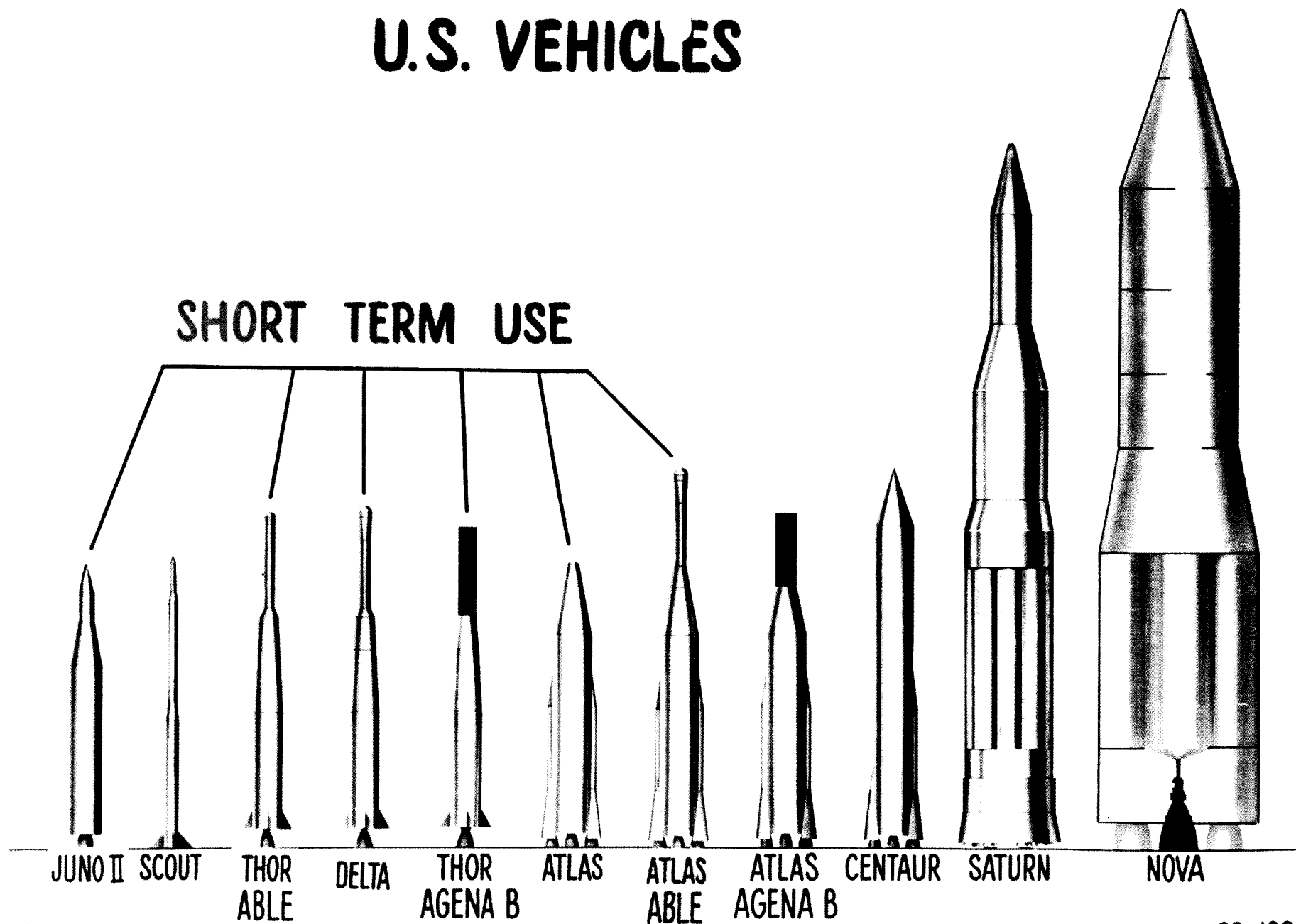
NASA's hope that cooperation in space research may indeed be truly worldwide.

The possibilities of cooperation with the USSR have been explored as opportunity presented. Discussion of preliminary nature was conducted in mid-November with the Chairman of the Soviet Commission for Interplanetary Travel, Professor Sedov, and another member of the Commission, Academician Blagonravov. This discussion took place during a visit of a USSR delegation to the American Rocket Society meeting in Washington. Soviet scientists expressed willingness to consider some form of cooperation in space activity, but stated their belief that such cooperation would have to proceed "step by step". The only step which they were at that time willing to discuss was the space conference under United Nations' auspices, which had been proposed by their representative in the United Nations. More recently, the NASA Administrator, Dr. T. Keith Glennan, in an address before the Institute of World Affairs in Pasadena, California, on December 7, 1959, offered the services of tracking stations to the Soviet Union, when, and if, it should conduct a man in space program.

Acknowledgements

I am grateful to the experimenters on Vanguard III and Explorer VII satellites, and the Pioneer V probe for providing information on their results; also to a number of my colleagues at NASA for helpful discussions and assistance, particularly John Lindsay, Herman LaGow, James Heppner, Maurice Dubin, Maurice Tepper, and Leonard Jaffe.

U.S. VEHICLES



LD-1-8

60-122

Fig. 1 U.S. Satellite and Space Probe Vehicles.
These vehicles form the basis for the
planned NASA space program.

ANTICIPATED GROWTH OF NASA SPACECRAFT SIZE

(IN TERMS OF THE WEIGHT OF A NEAR EARTH SATELLITE)

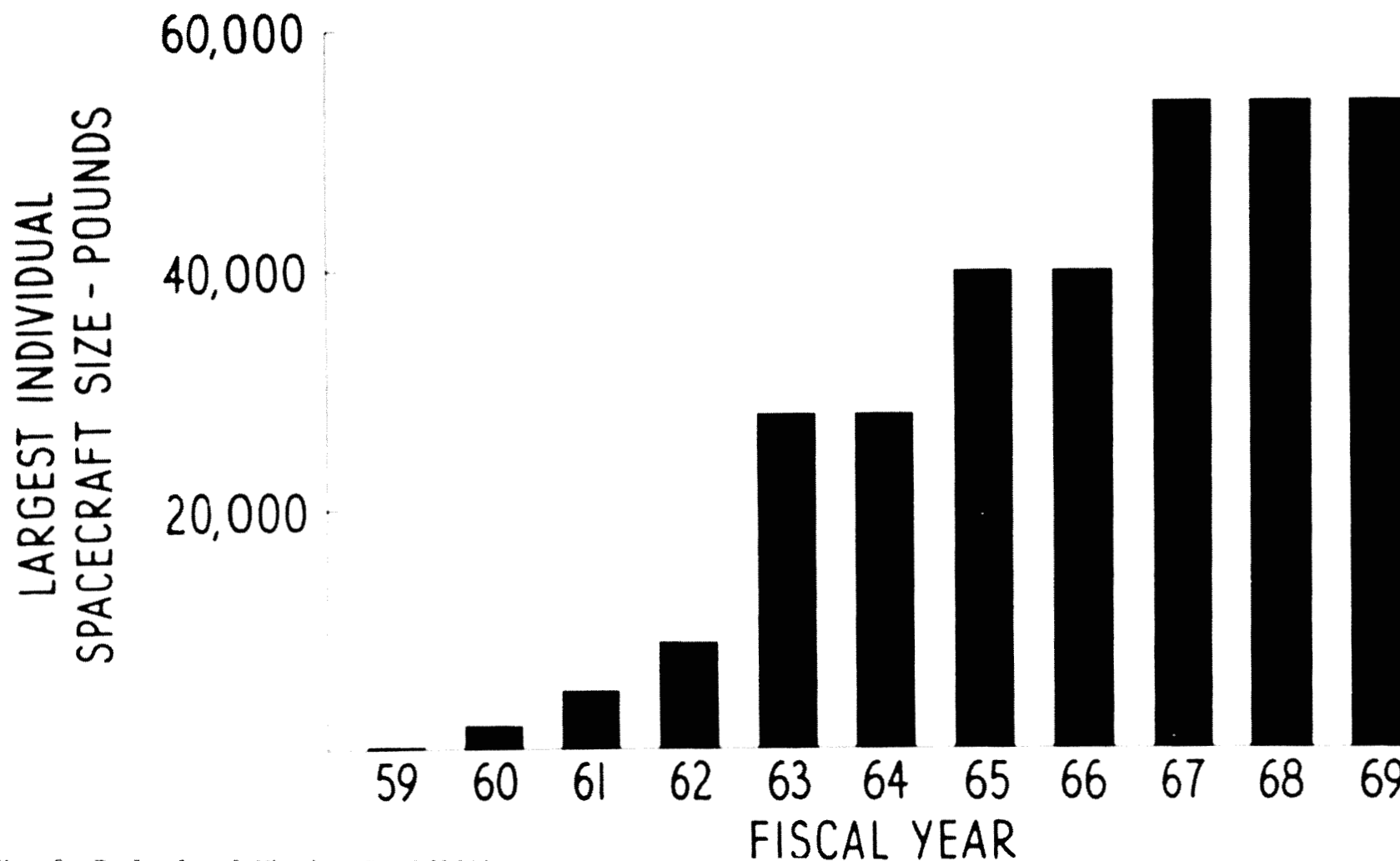


Fig. 2 Payload and Mission Capabilities.

As a result of the launching vehicle development work, the payload and mission capabilities of the National Aeronautics and Space Administration is expected to increase during the next decade as shown.

SCOUT

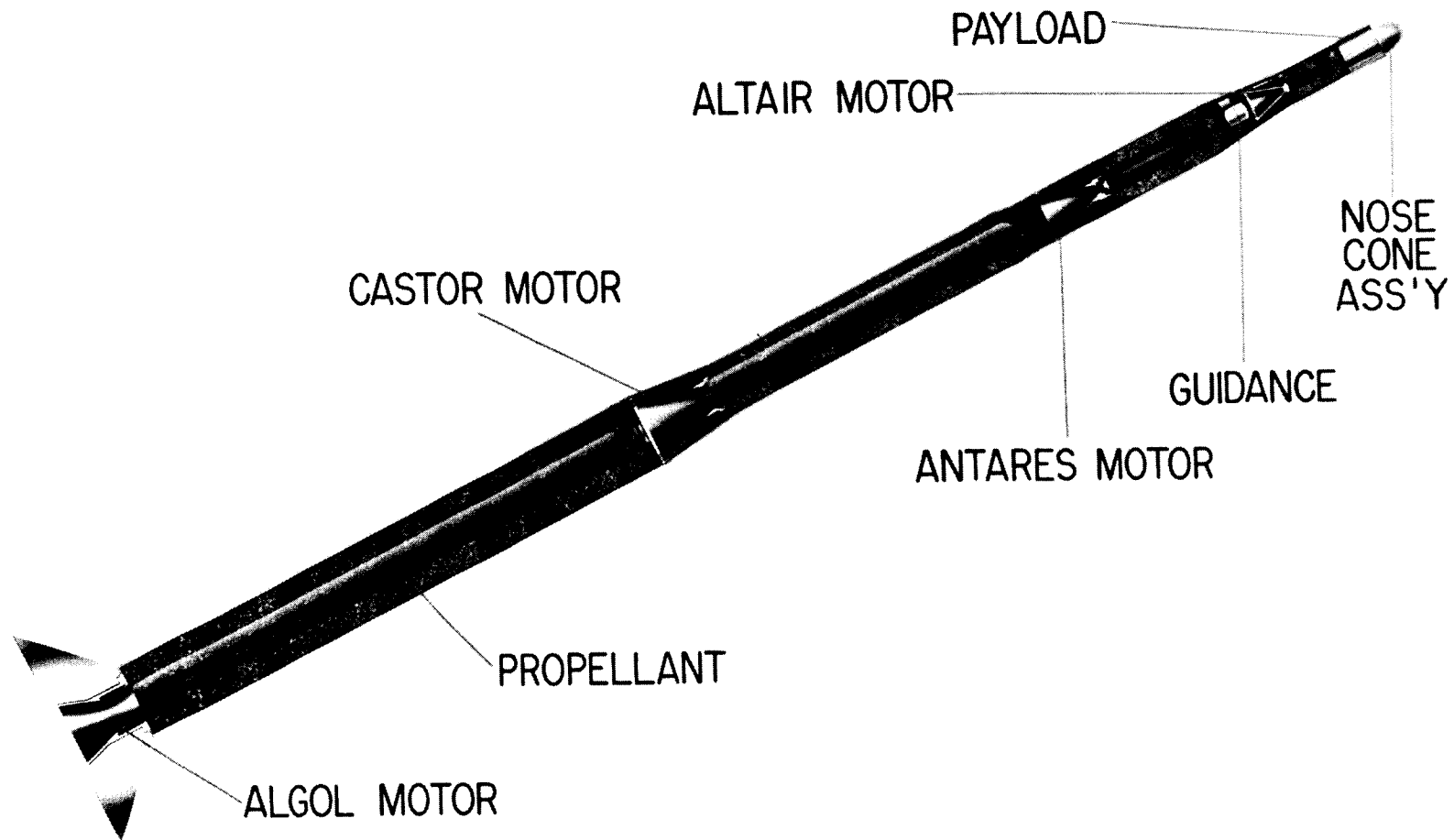


Fig. 3 The Scout Launching Rocket.
The Scout is intended to be
an inexpensive multipurpose
launching vehicle.

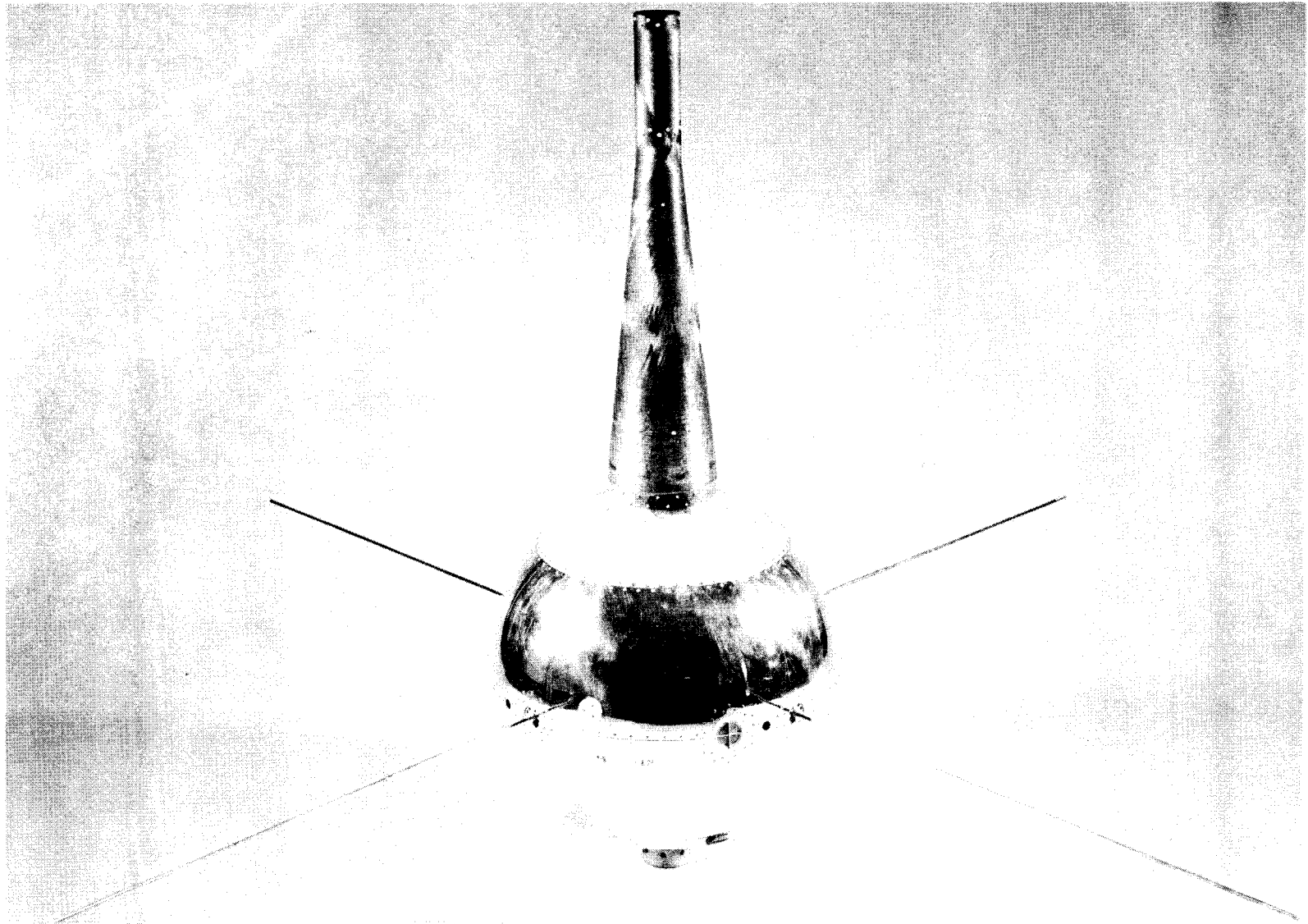


Fig. 4 The Vanguard III Earth Satellite.

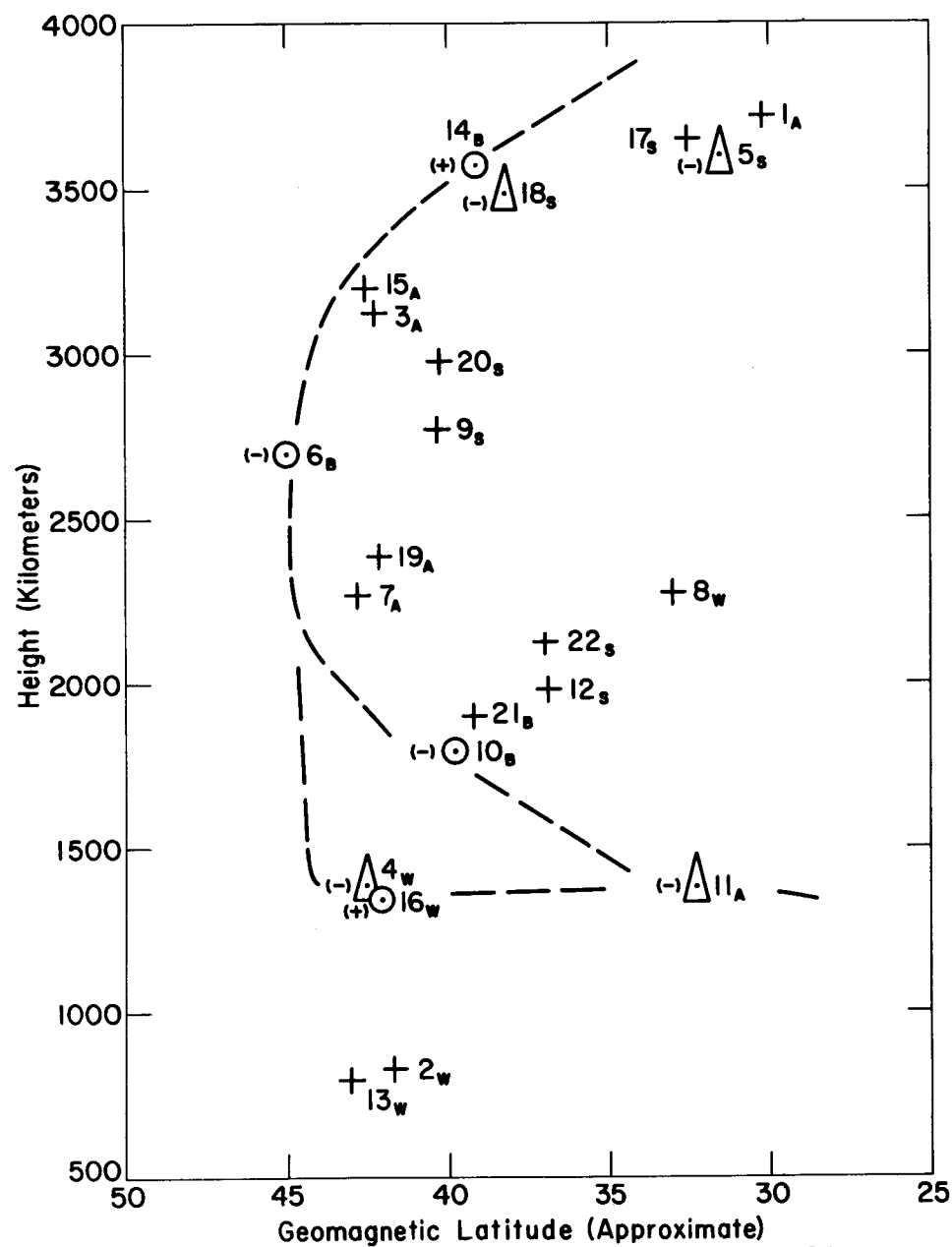


Fig. 4.1 Vangaurd III Magnetic Field Results.

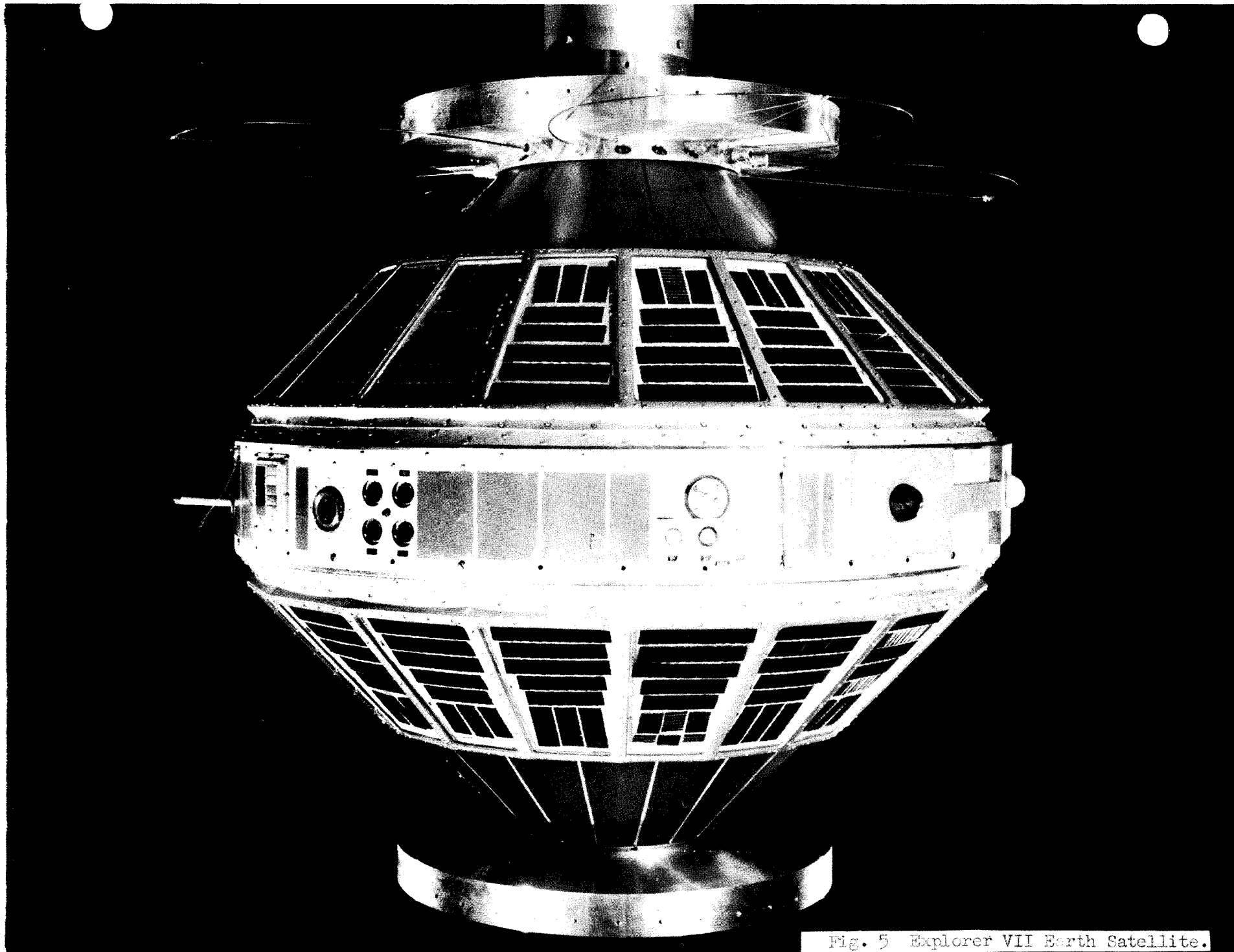


Fig. 5 Explorer VII Earth Satellite.

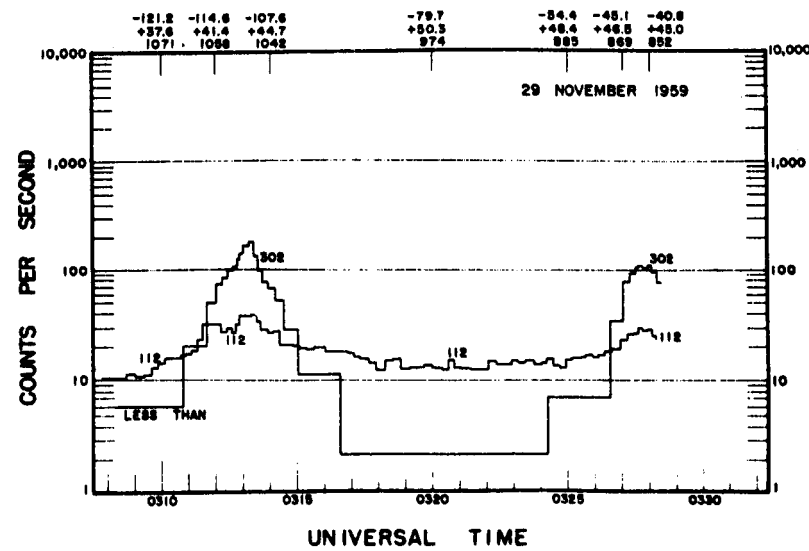
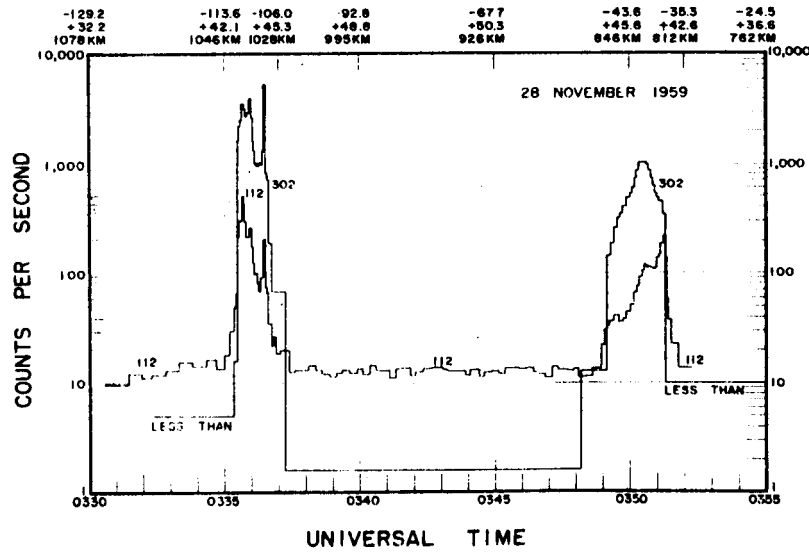
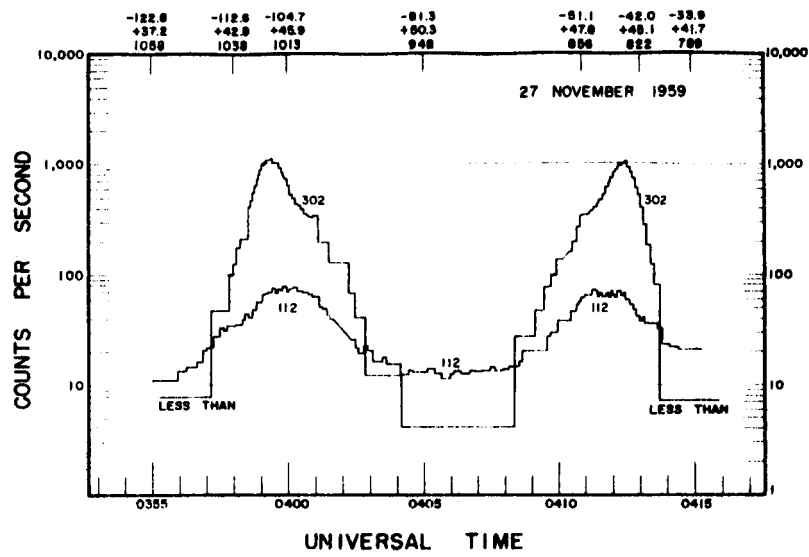


Fig. 5.1 Radiation Belt Observations from Explorer VII (1959 Iota I)

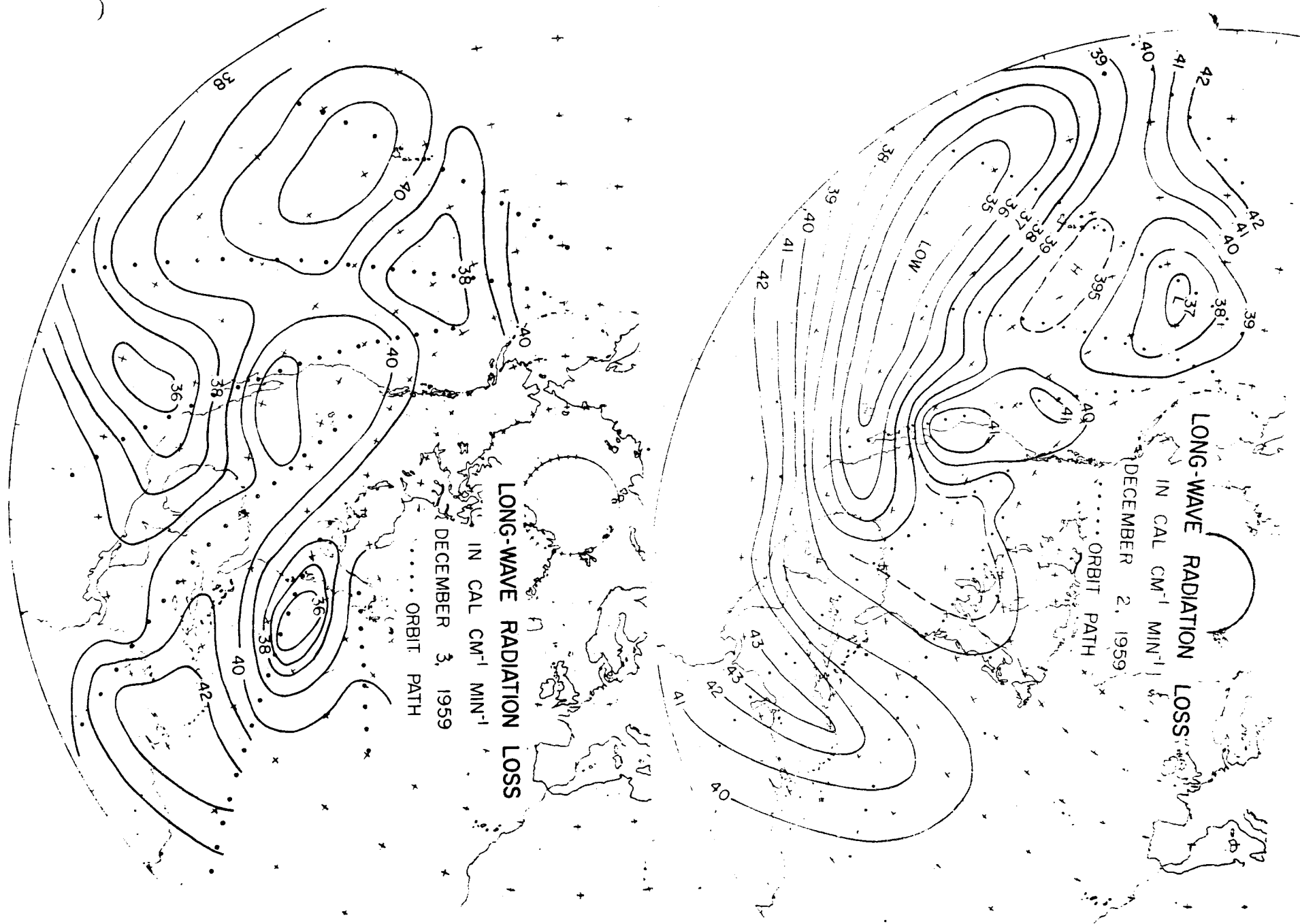


Figure 5.2 Atmospheric Radiation Balance Results from Explorer VII.

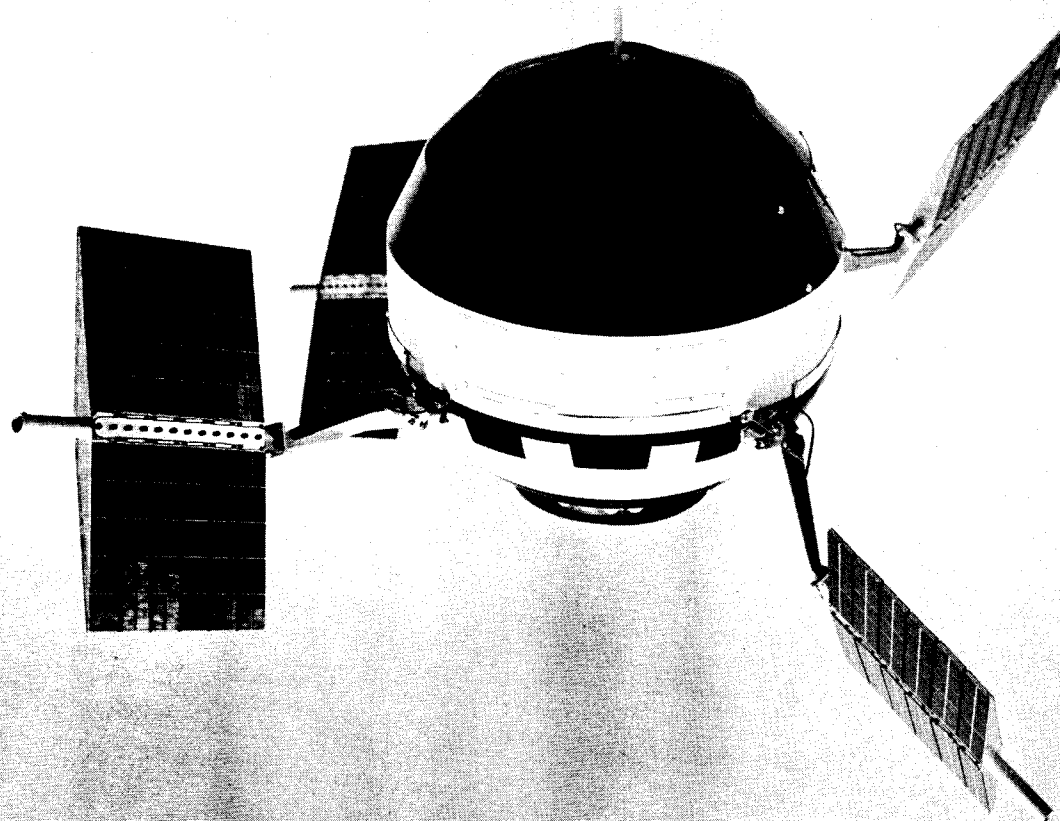


Fig. 6 The Pioneer V Deep Space Probe.

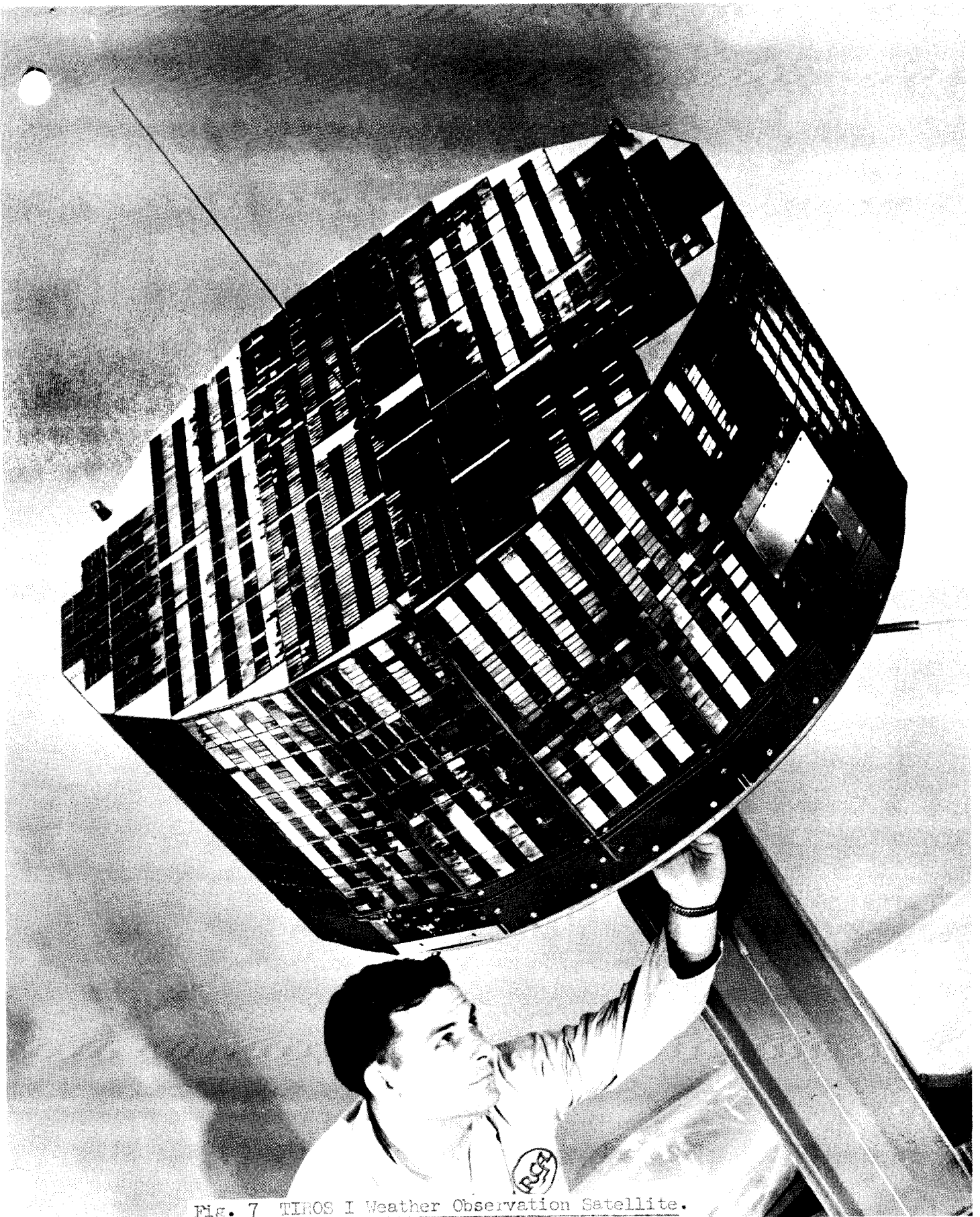


Fig. 7 TIROS I Weather Observation Satellite.

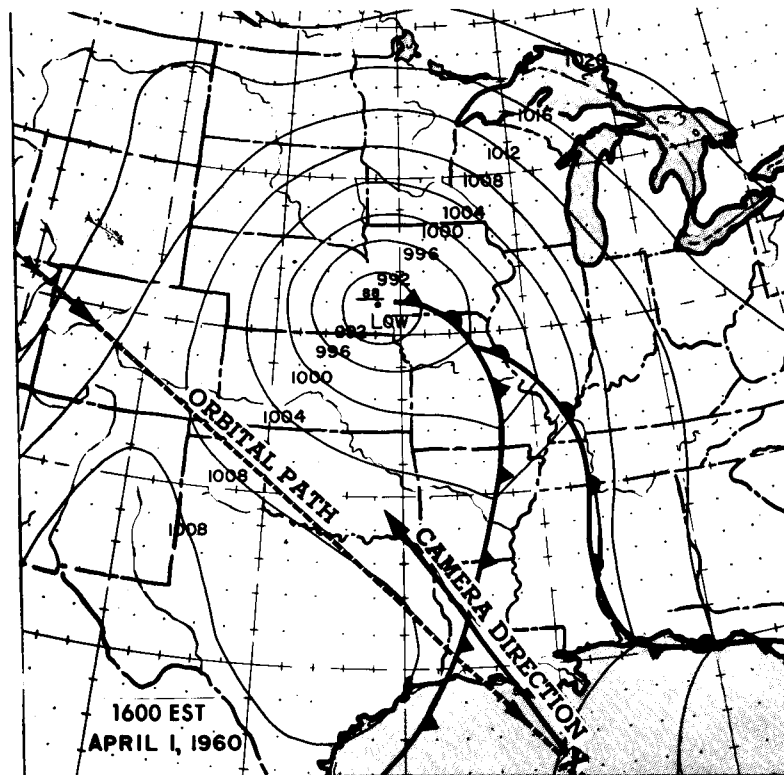
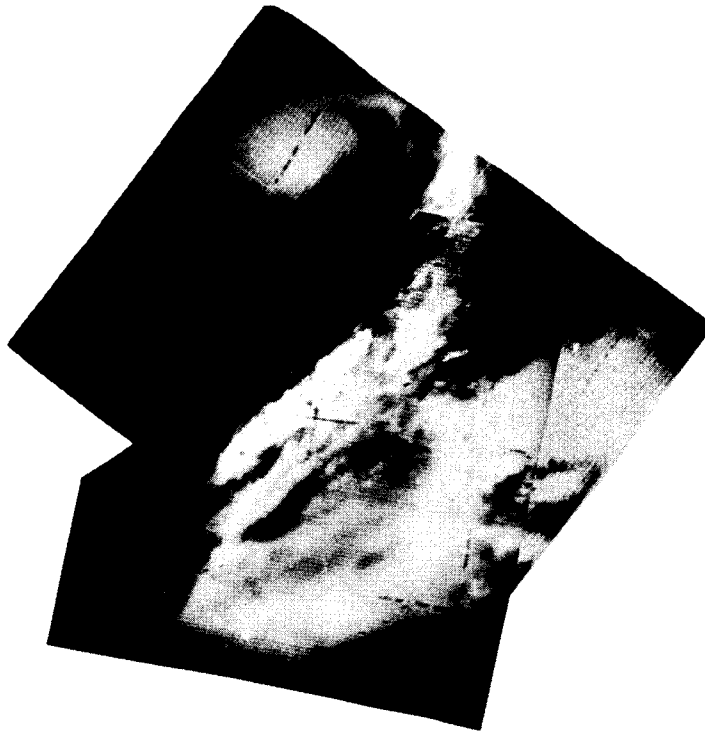
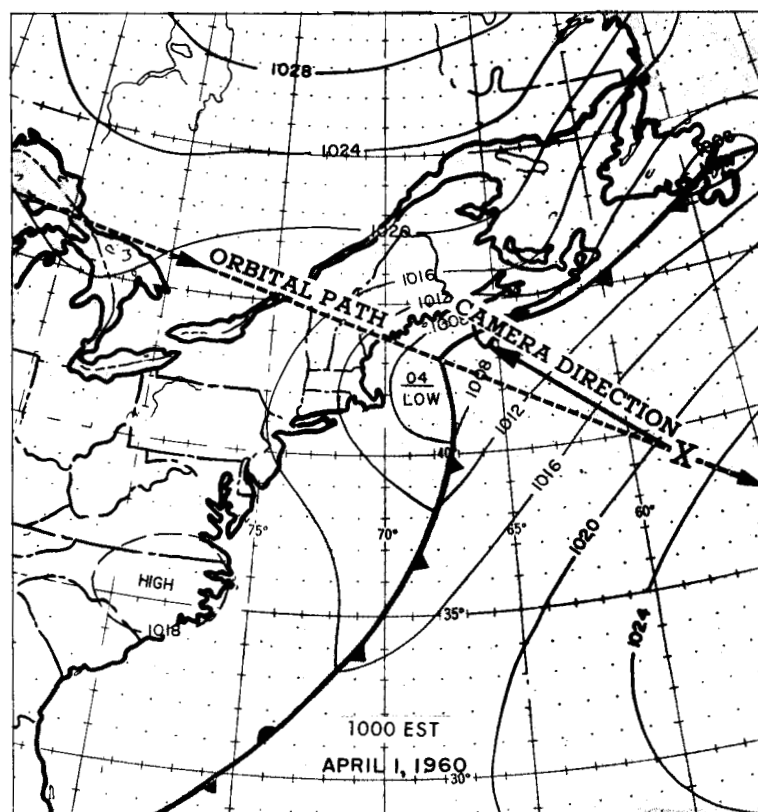


Fig. 8 Weather Picture Taken by the TIROS Satellite.



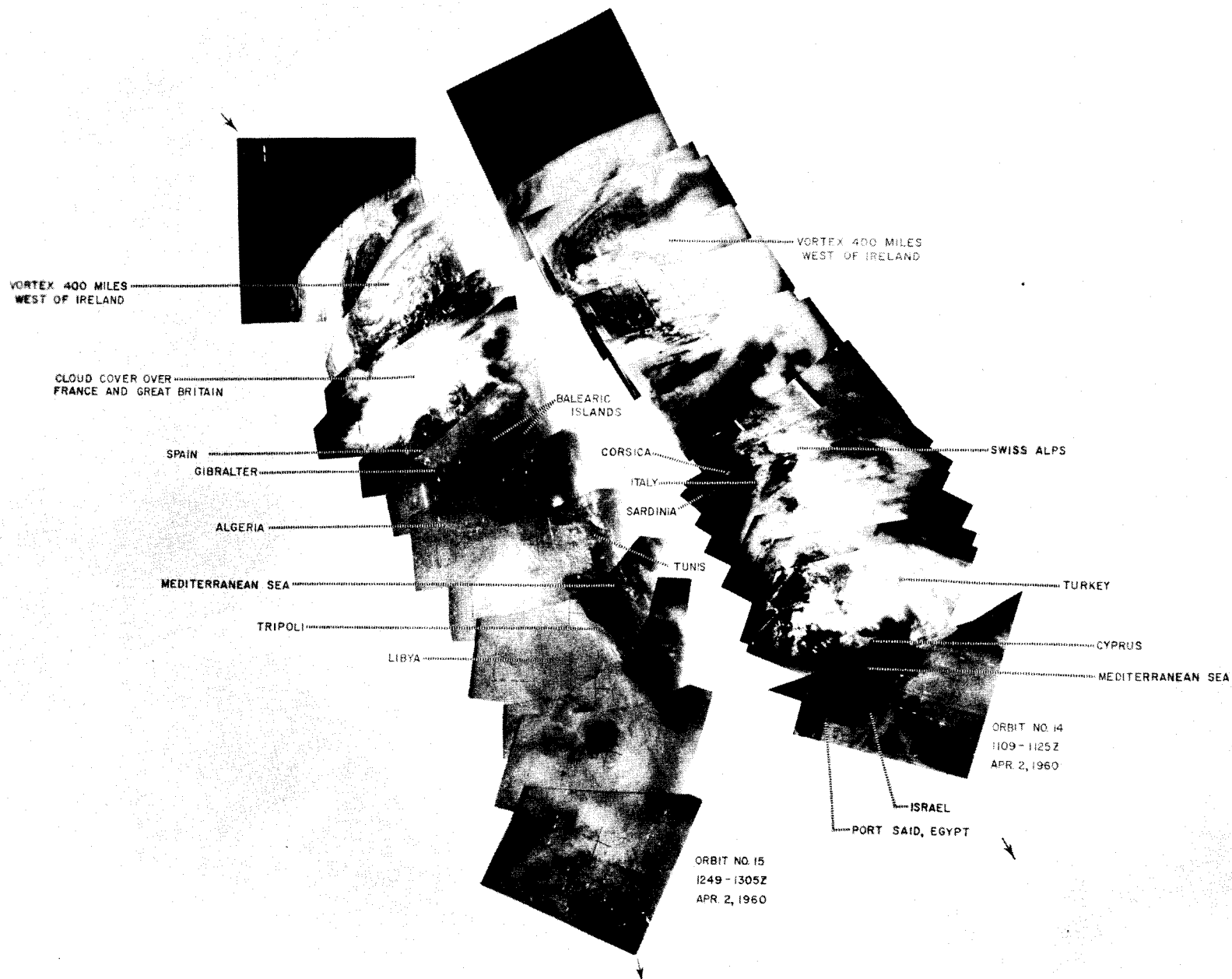
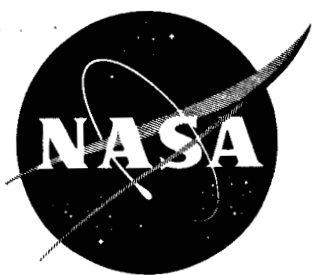


Fig. 10 Weather Picture Taken by the TIROS Satellite.



NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: IMMEDIATE RELEASE
Friday - May 27, 1960

RELEASE NO. 60-214

SHELBY THOMPSON APPOINTED DIRECTOR OFFICE OF TECHNICAL INFORMATION AND EDUCATIONAL PROGRAMS

Shelby Thompson has been appointed Director of the newly established Office of Technical Information and Educational Programs, Richard E. Horner, NASA's Associate Administrator, announced today. Mr. Thompson comes to NASA from the U.S. Atomic Energy Commission where he was Deputy Director of the Division of Information Services.

In addition to the responsibility for acquisition and dissemination of technical information, such as scientific reports, Mr. Thompson's office will conduct educational programs about the work of the National Aeronautics and Space Administration. The new office, which becomes effective May 31, will report to the Associate Administrator.

Mr. Thompson joined the Atomic Energy Commission in 1947 as the agency's first Chief of Public Information Services. In 1955 he was appointed Deputy Director of AEC's division in charge of public and technical information programs. While head of public information, he was in charge of the first observation by U.S. newsmen and civil defense representatives of a nuclear fission bomb detonation in Nevada. Later he conducted a similar group to the Eniwetok Proving Ground in the Pacific for observation of a thermonuclear bomb detonation.

Mr. Thompson was Executive Officer of the Bureau of Publications and Graphics, Office of War Information, and Special Assistant to the Executive Director of the U.S. Civil Service Commission between 1942

and 1944. He then joined the United Nations Relief and Rehabilitation Administration as Deputy Director of Public Information in Washington and overseas. In 1946, he was appointed Special Assistant to the Federal Power Commission in charge of public information activities. Thompson entered U.S. Government service in 1939 as an information specialist with the Department of Agriculture.

Earlier assignments have included responsibility for news photo, wire photo, and feature service of the central division of the Associated Press in Chicago, and reporting and editing for daily newspapers and the Associated Press in the Rocky Mountain region.

A native of Cheyenne, Wyoming, Thompson was born July 19, 1907. He attended the University of Wyoming.

Mr. and Mrs. Thompson, the former Zita Miller of Cheyenne, have two sons, Shelby M., 19, and Durke G., 17. Their home is in Bethesda, Maryland.

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